CHILTON'S
AUTOMOTIVE INDUSTRIES
SINCE 1895

NOVEMBER 1987

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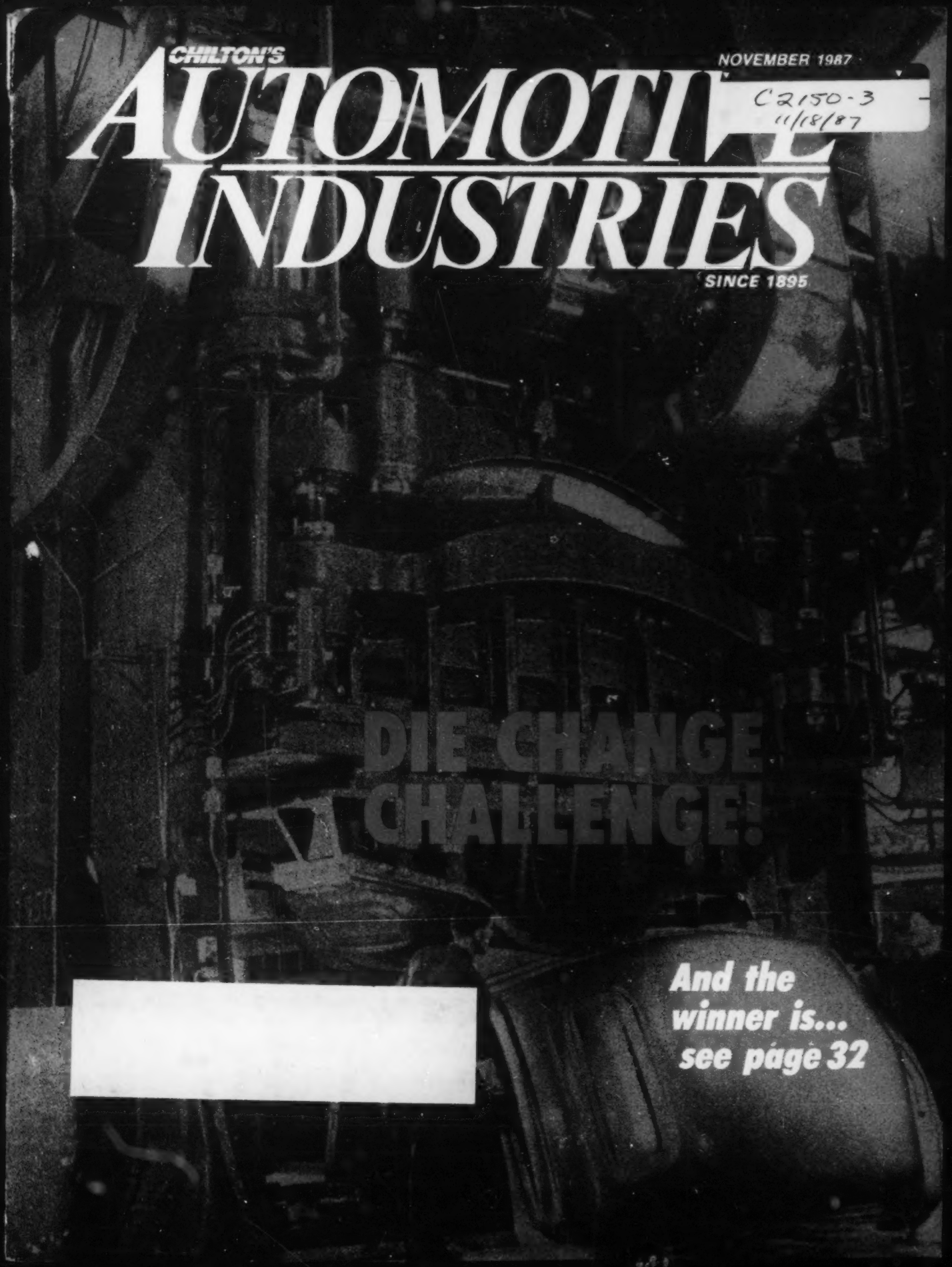

DIE CHANGE CHALLENGE!

And the winner is... see page 32

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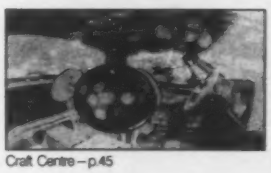

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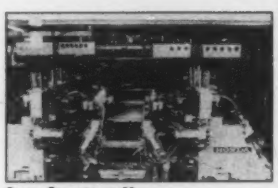

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AUTOMAKER QUARTERLY REPORT

Imports grab four of the top ten sales spots for the 3rd quarter.

by Dr. Thomas O'Grady

Foreign makers are quickly becoming residents of the sales top ten. For the third quarter, imports occupy fourth, fifth, ninth and tenth place in sales. Compared to last quarter, the Hyundai Excel moved up from sixth to fifth, while GM's Cavalier fell to seventh.

The Toyota Camry is a new arrival at number ten. Nissan's Sentra moved up to ninth.

The good news for GM is that the Corsica/Beretta moved from ninth in quarterly sales all the way to number three. It was inevitable that some of those sales would come from the Cavalier and the Celebrity – the latter of which dropped from third in sales to eighth.

Ford again held on to the Number One and two spots with Escort and Taurus.

Toyota's Camry is a new entry into the top ten. This bodes well for the opening of Toyota's Kentucky plant with three Camry models. If Toyota continues with some imports as well as its domestic production, I expect the Camry to do even better. Otherwise, the company's days' supply of Camry will run low.

Dr. Thomas O'Grady heads Integrated Automotive Resources, Inc. in Wayne, Pennsylvania.

The Hyundai Excel is an interesting car. Although it is but one carline, many variations give it considerable breadth.

Market shares are continuing to shift. The domestics had slight declines. The import companies, which were experiencing problems early in the year, appear to have worked harder recently.

In particular, Subaru and Volkswagen moved up 8.5% and 4.8%, or .13 and .09 percentage points, respectively, in market share.

1987 continues to be on target, at about a 10.1 million unit year. Next year, we will not experience the loss we suffered this year from the 1986 Tax Reform Act. That, and the effect of the presidential election year, should result in about a 10.6 million unit 1988. AI

WHAT'S HOT! Domestic Auto Sales (3rd Quarter Results)

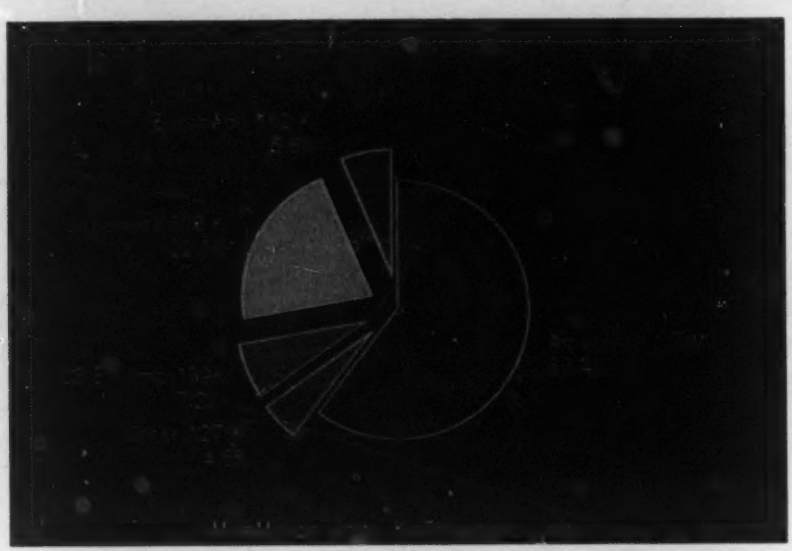
Carline	'87	'86	% Change
Escort	114,048	113,906	0.12%
Taurus	99,581	58,557	70.1%
Corsica/ Beretta	89,272	--	--
Accord*	87,084	81,428	6.9%
Excel	78,421	60,571	29.5%
Clera	70,049	92,816	(24.5%)
Cavalier	68,769	90,187	(23.7%)
Celebrity	62,677	100,327	(37.5%)
Sentra*	61,004	62,326	(2.1%)
Camry	53,252	40,421	31.71%

*–Includes imports
( )–Negative value

US Passenger Car Market Shares To Date

Manufacturer	Sales	% Total
General Motors	2,939,698	37.26%
Ford	1,593,613	20.20%
Chrysler	828,387	10.50%
Honda/Acura	525,662	6.66%
Nissan	450,839	5.71%
Toyota	434,633	5.51%
Subaru	130,572	1.66%
VW	148,829	1.89%

(Continued p.58)



Passenger Car Market Share By Geographic Base

Third Quarter 1987

Manufacturers	Total Sales	Total Market Share
American	1,669,952	60.4%
Japanese	607,879	22.0%
European	162,007	5.8%
US Built Imports (VWUS, Honda, NUMMI, Nissan, Toyota)	199,056	7.2%
Other Imports	127,673	4.6%
Total	2,762,567	100.00%

3RD QTR. DOMESTIC LIGHT TRUCK PRODUCTION

COMPANY	FULL-SIZE TRUCKS	COMPACT TRUCKS	FULL-SIZE VANS	COMPACT VANS	FULL-SIZE SPORTS UTILITY	COMPACT SPORTS UTILITY	TOTAL 1986	TOTAL 1987
FORD	104,077	70,803	50,623	39,663	12,051	32,102	1,433,317	1,139,134
CHEVROLET	125,832	61,208	38,671	39,222	7687	47,618	1,245,190	967,516
CHRYSLER	24,581	18,366	15,568	87,097	4444	—	576,136	529,116
GMC	44,308	15,217	11,440	10,422	5429	11,037	390,176	298,257
JEEP	—	9959	—	—	3875	37,586	NA	159,432
NISSAN	—	23,975	—	—	—	—	108,048	67,431

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ALFA 164!

Here Comes Fiat... Again

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Vittorio Ghidella is out to court US customers – passionately.

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An alphabetical listing of the industry's top OEs.

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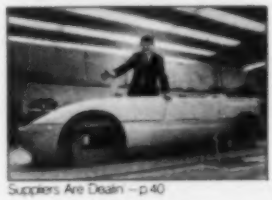
*Not found in all issues.



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Getting design and manufacturing together – simultaneously.

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SUPPLIER 100

An alphabetical listing of the industry's top OEMs.

	1986 Sales*	1986 Profit*	% Return On Sales	% Return On Equity
AC Spark Plug (GM)	1	1	1	1
Accustar/Chrysler	22,514	1,404	6.2	22.5
Alcoa	4,667	254	5.4	(9.22)
Allied Signal	11,794	605	5.1	(1.3)
Allis-Chalmers	771	(8.6)	NA	(36.3)
AMP	1,933	164	8.5	2.2
Atlantic Richfield	14,585	615	4.2	1.
Armco	3,086	(472)	4.2	11.4
Armstrong Rubber	866	(37.6)	NA	(9.9)
Armstrong World Ind.	192	122	6.4	36.8
Ashland Oil	6,991	208.6	3.0	54.8
Atlas Copco	NA	NA	NA	NA
Ball Corp.	1,070	58.9	5.5	16.6
BASF/Inmont	3,645	104.6	2.9	NA
Bethlehem Steel	4,333	(152.7)	NA	(60)
Borg Warner	3,623	206.3	5.7	67.2
Robert Bosch	NA	NA	NA	NA
Briggs & Stratton	745	34.1	4.6	22.1
Budd Co.	NA	NA	NA	NA
Caterpillar	7,321	76.0	1.0	(3.4)
Celanese	2,891	213.0	7.4	63.5
Central Foundry (GM)	1	1	1	1
Champion Spark Plug	883.8	17.2	2.0	15.2
Cincinnati Milicron	850	23.3	2.7	15.8
Clark Equipment	954	(60.6)	NA	(22.8)
Colt Ind.	1,616	89.3	5.5	(83.7)
Cross & Trecker	NA	NA	NA	NA
Crown Cork & Seal	1,619	79.4	4.9	15.1
Cummins Engine	2,304	(107)	NA	(3.6)
Dana Corp.	3,695	85.9	2.3	33.2
Deere & Co.	3,516	(229.3)	NA	(18.2)
Delco Elect. (GM)	1	1	1	1
Delco Moraine (GM)	1	1	1	1
Delco Products (GM)	1	1	1	1
Delco Remy (GM)	1	1	1	1
Detroit Diesel (GM)	1	1	1	1
Dow Chemical	11,113	732	6.6	48.0
Dow Corning	1,085	110.6	10.2	NA
Dresser Ind.	3,661	9.6	0.3	10.4
DuPont	27,148	1,538	5.7	28.4
Eagle Picher Ind.	648.3	38.8	6.0	23.9
Eaton	3,812	137.6	3.6	17.6
Emhart	2,094	(10.2)	NA	3.3
Federal Mogul	941.6	3.6	0.4	8.2
Firestone	3,712	85.0	2.3	20.5
Fisher Guide (GM)	1	1	1	1
FMC Corp.	3,003	152.5	5.1	(60.5)
Ford	62,716	3,285	5.2	51.4
Ford Divers. Prod.	1	1	1	1
GenCorp	3,099	130.0	4.2	11.4
General Electric	35,211	2,492	7.1	21.9
General Motors	102,814	2,945	2.9	.2
BF Goodrich	2,553	32.7	1.3	34.5
Goodyear	10,328	124.1	1.2	40.3
Gould	1,437	(101.8)	NA	(46.2)
ICI	1,500	824	5.5	NA
Inland Steel	3,173	19.3	0.6	3.3
IPC	NA	NA	NA	NA
ITT	7,895	493.7	6.3	43.55
Kaiser Aluminum	2,233	(32.7)	NA	(18.38)
Kelsey Hayes	NA	NA	NA	NA
Lear-Siegler	NA	NA	NA	NA
LTV	7,271	(3,251)	NA	43.07
Mack Truck	1,711	(30.56)	NA	2.35
Magna International	NA	NA	NA	NA
Mobay	NA	NA	NA	NA
Monsanto	6,879	433.0	6.3	66.42
Motor Wheel	NA	NA	NA	NA
National Steel	NA	NA	NA	NA
Navistar Intl	3,356	1.73	0.1	(44.12)
New Departure/Hyatt	NA	NA	NA	NA
Norton Corp.	1,107	(33.1)	NA	0.82
Owens-Corning Fibrgls	3,644	15.6	0.4	(62.66)
PACCAR	1,795	54.2	3.0	5.76
PPG Industries	4,687	316.4	6.8	46.9
Rexnord	1,093	(103.7)	NA	33.4
Reynolds Metals	3,638	191.8	5.3	7.62
Sealed Power	665.8	28.5	4.3	(2.17)
Sheller Globe Corp.	940.0	NA	NA	NA
Sherwin Williams	2,253	105.9	4.7	26.53
A.O. Smith Corp.	964.6	28.9	3.0	(8.26)
Signal Companies	NA	NA	NA	NA
Stanadyne	492.7	21.1	4.3	21.73
Stanley Works	1,549	78.7	5.1	22.82
Sterling Eng. Prod.	NA	NA	NA	NA
Textron	5,226	239	4.6	32.7
TRINOVA	1,447	122	8.5	46.3
TRW	6,450	217.7	3.4	(0.9)
Teledyne	3,241	238.3	7.4	(2.77)
3M	NA	NA	NA	NA
Timken	1,058	2.73	0.3	(1.8)
USX	14,000	(1,833)	NA	(14.62)
Union Carbide	7,828	496.0	6.3	25.85
Uniroyal	NA	NA	NA	NA
United Technologies	15,669	72.7	0.5	8.21
Walbro Corp.	NA	NA	NA	NA
Weirton Steel	1,173	45.08	3.8	NA
White-Consolidated	NA	NA	NA	NA
Wickes Companies	NA	NA	NA	NA
Witco Corp.	1,355	65.2	4.8	48.34

* – In millions of dollars. Figures taken from Fortune 500 and company annual reports. [1]GM and Ford do not list divisional figures separately. NA – No public listing or not available.

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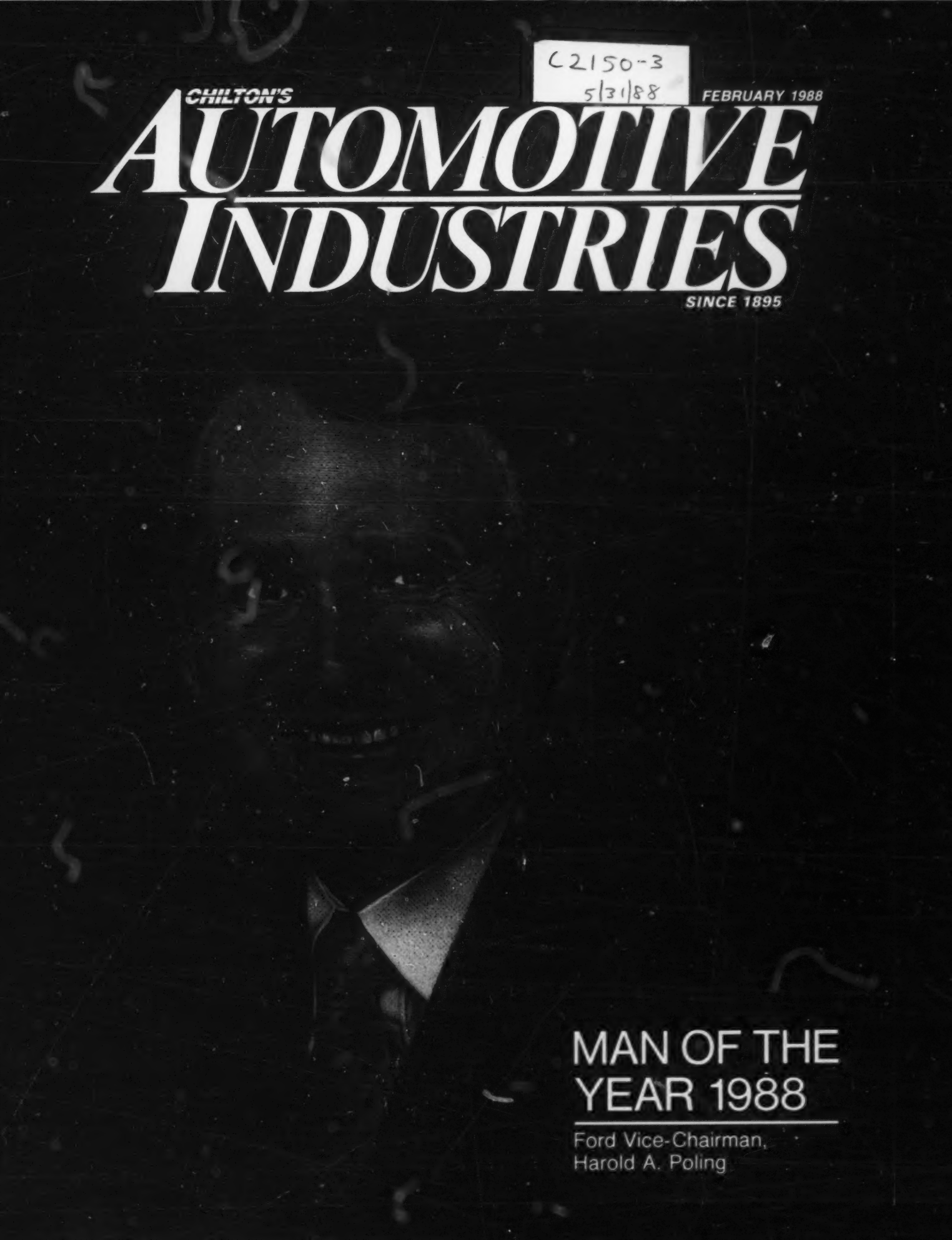
FEBRUARY 1988



MAN OF THE YEAR 1988

Ford Vice-Chairman,
Harold A. Poling

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Cover. Ford vice-chairman Harold A. "Red" Poling, 1988 Man of the Year. Painting by Randy Hamblin

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CHILTON COMPANY, *PART OF CAPITAL CITIES/ABC, INC.*

AUTOMAKER QUARTERLY REPORT

1987's unlikely winners in sales and market share.

by Dr. Thomas O'Grady

1987 was the first year of major turmoil in the automotive industry, but is still only a mild prelude to the next three years. Major losers of sales and share during the year included GM, Chrysler, Audi, Porsche and Jaguar.

But Ford, Hyundai, Honda and Toyota won big in '87. Most of the European marques lost sales but managed to gain slightly in market share as the entire industry fell by 10.5%

Small manufacturers Isuzu, Mitsubishi and Yugo actually grew. Yugo held on to its low price for much of 1987 and saw its sales climb by 33%. For 1988, Yugo will continue to be worth watching as base price increases to $4199, and a one-year warranty on wearable parts is added.

With its "Joe Isuzu" ads, Isuzu developed name recognition which translates into sales. In 1988, Isuzu must broaden and focus its image before US production starts in late 1989.

Dr. Thomas O'Grady heads Integrated Automotive Resources, Inc. in Wayne, Pennsylvania.

Mitsubishi's lineup will be tested in '88, even with the '89 Galant and Mirage due to debut. A significant sales push will be needed before Diamond Star adds 120,000 units.

Toyota's '87 products were in fairly short supply, but they will need to further advance their image to guarantee success for the US-built Camry which is planned for as much as 240,000 units. The Kentucky plant will free up volume for the Lexus line in 1989.

In 1987, Ford cashed in on its growing reputation for quality, taking market share away from GM. By the end of 1988, however, GM will strengthen considerably, with new cars such as Reatta, the GM10s, extended E and K luxury cars, and modified A-cars.

BMW and Audi territory is being invaded by Honda's Acura cars, although BMW is still strong in the upper end of the luxury segment. As Acura establishes itself, it will become harder for Audi to win back lost share.

1988 forecast: 10.0 million cars. AI

WHAT'S HOT! Domestic Auto Sales Calendar Year 1987

Carline	'87	'86	% Change
Escort	392,360	402,181	(2.44%)
Taurus	354,971	263,450	34.74%
Accord*	334,876	224,200	49.36%
Cavalier	307,028	357,112	(14.02%)
Celebrity	306,480	408,946	(25.06%)
Excel	263,620	168,882	56.10%
Ciera	244,607	329,930	(25.86%)
Sentra*	235,945	217,496	8.48%
Tempo	219,296	265,382	7.37%
Corsica/ Beretta	214,074	--	--

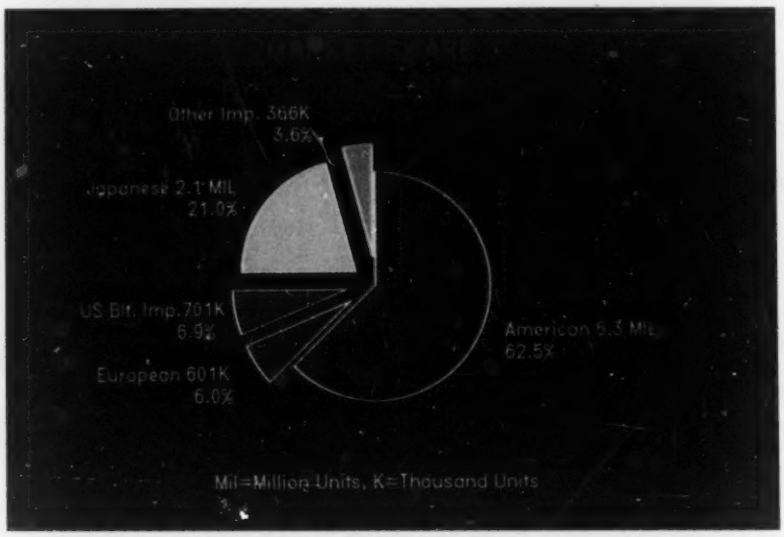
*—Includes imports
( )—Negative value

US Passenger Car Market Shares, 1987*

Manufacturer	Sales	% Total
General Motors	3,728,310	36.59%
Ford	2,060,834	20.23%
Chrysler	1,094,390	10.74%
Honda/Acura	738,306	7.25%
Toyota	620,133	6.09%
Nissan	524,785	5.15%
Hyundai	263,610	2.59%
VW	222,638	2.19%
Mazda	207,337	2.03%
Subaru	175,864	1.73%

*Calendar year

(Continued p.76)



Passenger Car Market Share By Geographic Base

Calendar Year 1987

Manufacturers	Total Sales	Total Market Share
American	6,376,561	62.58%
Japanese	2,143,218	21.04%
European	601,727	5.91%
US Built Imports (VWUS, Honda,NUMMI, Nissan	701,082	6.88%
Other Imports	366,100	3.59%
Total	**10,188,688**	**100.00%**

1987 DOMESTIC LIGHT TRUCK PRODUCTION

COMPANY	FULL-SIZE TRUCKS	COMPACT TRUCKS	FULL-SIZE VANS	COMPACT VANS	FULL-SIZE SPORTS UTILITY	COMPACT SPORTS UTILITY	TOTAL 1986	TOTAL 1987
FORD	607,798	317,938	237,433	187,919	57,004	135,770	1,433,317	1,543,862
CHEVROLET	535,055*	208,554	158,225	163,508	34,431	170,664	1,244,654	1,082,737
CHRYSLER	97,118	124,609	102,144	380,792	21,796	--	576,136	726,459
GMC	177,957*	57,349	52,609	41,302	9,499	51,614	371,603	390,330
JEEP	1,252	43,676	--	--	14,743	189,869	NA	249,540
NISSAN	--	102,637	--	--	--	--	108,048	102,637

*Includes Suburban and P-model

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CHILTON'S
MARCH 1988

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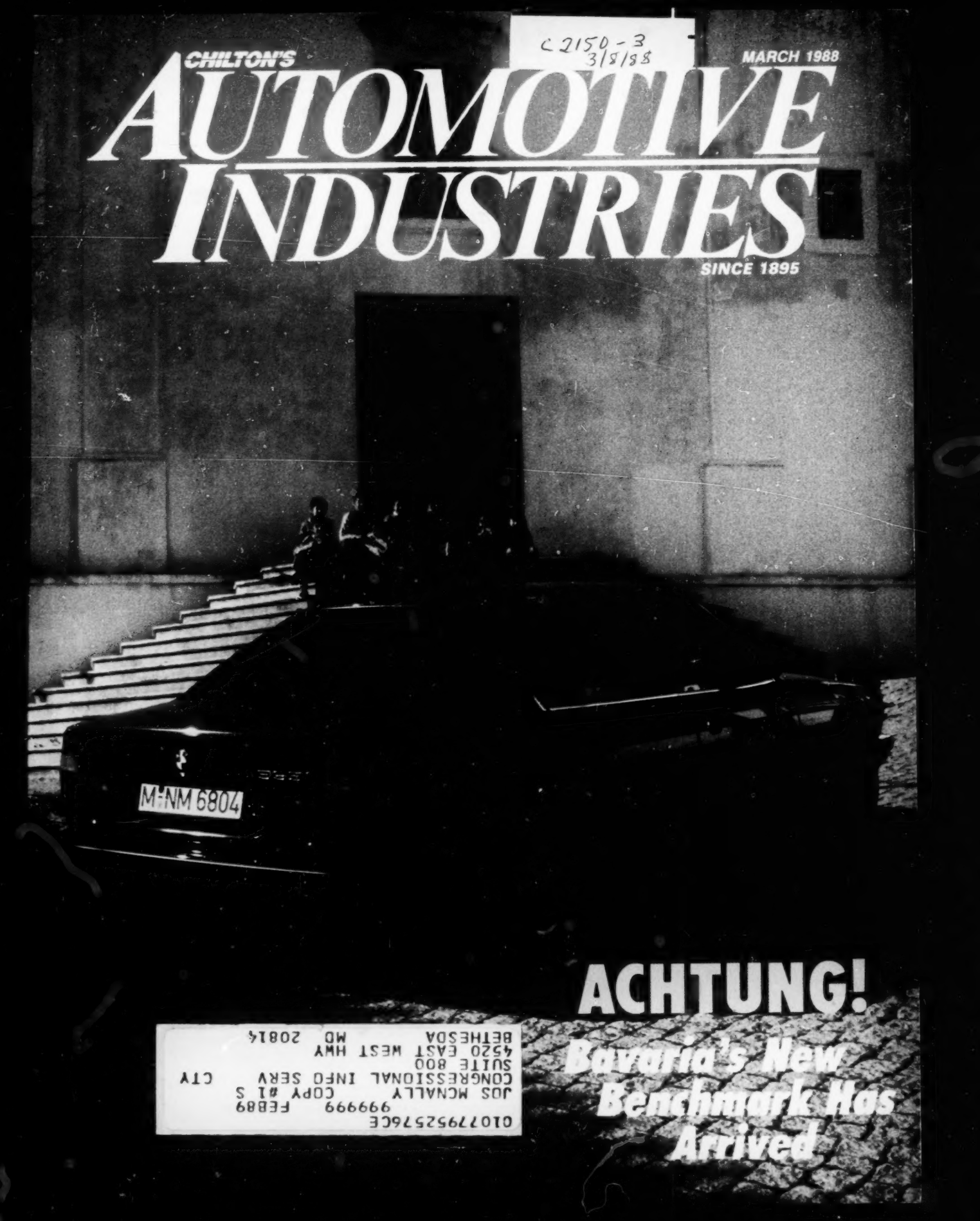

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CHILTON COMPANY, *PART OF CAPITAL CITIES/ABC, INC.*

OUTSOURCING: THE DOUBLE-EDGED SWORD

Some things an automaker should always engineer in-house

by John McElroy

"Don't even mention Getrag to me—it just makes me mad," says a powertrain engineer with over 30 years at General Motors. "We had the talent, the manpower and the resources to design a smooth-shifting five-speed gearbox right within General Motors. But some of the people running the company didn't want any part of that."

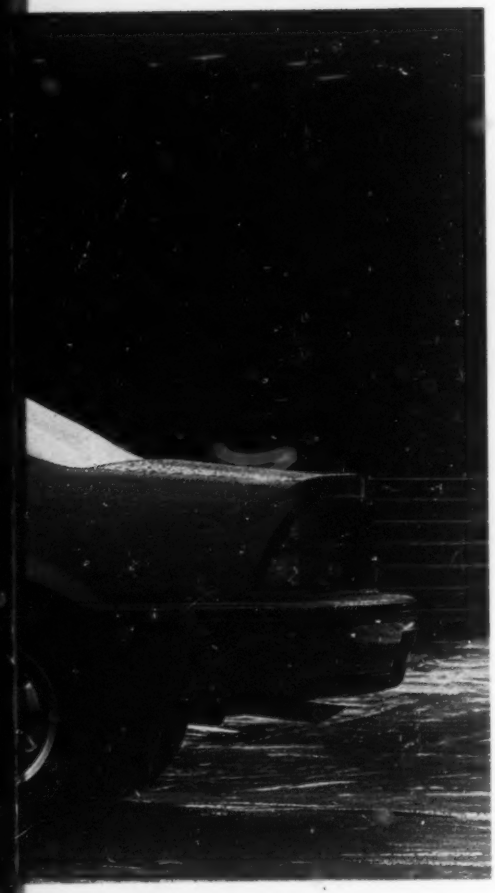
When General Motors turned to Getrag to design a manual five-speed transaxle, it left a bitter taste in the mouths of many GM engineers. Outsourcing simple parts and components is one thing, they say. But outsourcing the engineering that makes up the character of a car is another matter altogether. While auto executives like to cite the time and cost savings that outside engineering firms provide, there are others who think that outsourcing engineering has gone too far.

In The Beginning

When the American automotive industry was in its infancy, the fledgling car companies found that they needed many components and services that simply couldn't be purchased elsewhere. Whether it was research, engineering or even cost accounting, they had to build up the in-house capability to provide these services. This also gave them proprietary technology that provided their cars with unique characteristics.

After World War II and the explosive market growth that resulted from peacetime prosperity, the automakers found there were times when they couldn't keep up with the design work needed to bring out all the new products they wanted to rush to the market. So they turned to outside drafting firms to handle the spill-over. But it rarely went beyond drafting.

By the end of the 1970s, however, that all began to change. The need to



Original Chevy II, with four body styles, took only 15 months from concept to production. GM wishes it could've even come close with Corsica/Beretta.

cut costs and head-count encouraged the Big Three to do more engineering on the outside. Often the automakers found that outside engineering firms were more in tune with the latest technology. These firms were also able to develop new products much faster than the bureaucracy-ridden staffs at GM, Ford and Chrysler.

As a result, today Detroit is literally booming with outside engineering firms that are getting more and more design work to do. But why are these outside firms able to operate so much more efficiently?

"You have to ask whether the work you do is an end or a means," explains Hulki Aldikacti, president of Entech, an engineering firm in Troy, MI. "Let's say we start a hardware store. Our job is to sell hardware. Then we decide we need to do bookkeeping to keep track of all our parts. That is a means.

"So we decide to hire our cousin who is real good with computers," continues Aldikacti. "We make him department head and before you know it he needs an assistant. But we're in the business to sell hardware, not to run computers. So then we find there is a company that is selling services to do books much cheaper. That is their end.

"Whenever you drive for an end, you're efficient," he maintains. "But whenever something is a means, and you put it under your roof, I guarantee it will become a bureaucracy and inefficient."

The Dangers Of Outsourcing

At the rate the American automakers are outsourcing their engineering work, the total annual market for outside engineering will grow to $1 billion by 1990, if it's not there already. Yet, efficiency alone is not the driving force behind this move.

"Outsourcing gets you to specialists who work the job on a daily basis," says Warren Hirshfield, who recently moved from Cadillac to become general manager of SDRC's automotive services. "Whereas an auto company might do a new body every five years, the pure engineering houses do that work on a more regular basis."

Because of the efficiency and expertise these firms offer, it is difficult to find a top-level executive at one of the Big Three who feels that outsourcing is bad for the company. In fact, they welcome the trend.

"Right now, we're moving very, very fast," reasons Bob Stempel, president of General Motors. "And I want all the technology. I want everything done not one after another, but side by side. Isn't it wonderful to have all that technology simultaneously?"

Yet once you step a few rungs down the management ladder, there are more than a few people who feel uncomfortable with the trend to outsourcing engineering.

"Can an auto company let everything be outsourced and just be an assembler?" asks SDRC's Hirschfield. "I worry about that. There's got to be limits because you can carry that too far."

But why would anyone be concerned about turning their engineering over to companies that can do it faster, cheaper and better?

"Once you move outside with many businesses doing your engineering, it begins to level off the differentials that separate one car from another. The more fragmented the designs of all these components becomes, the less character a car will have. And it's the cars that have the most character that are the best in the long run," notes Alex Mair, ex-VP of GM's Technical Staffs, now retired.

Maintaining Brand Image

The reason outside engineering firms can't design the identity of a car is because character cannot be boiled down to an engineering specification.

"How do you define the difference between a Ford, a Cadillac and a Mercedes? Mechanically, they're identical," states Hulki Aldikacti. "If I make a parts list, they have four wheels, they have an engine, and axles and seats and a steering wheel. When you

break them down to a parts list, you can't tell a Cadillac from a Mercedes. But when you see a Cadillac, you know it's a Cadillac."

The character that defines what makes a Cadillac comes from the "Private Knowledge" of the people at Cadillac, Aldikacti explains. Private Knowledge, he says, is a reflection of each company's own distinctive culture. It can't be written in a book, it can't be taught, it can't be digitized – and it can't be outsourced. The only way you can absorb it is by working at the company over many years.

According to the experts *AI* contacted for this story, the most important feature that determines the character of a car is its styling, both interior and exterior. But it also involves the performance of the powertrain – right down to the exhaust note. It includes the seat design and positioning, as well as the subjective feel of all the controls, and whether they should be rotary knobs, push buttons or toggle switches. It even includes the proper 'ker-chunk' of a closing door. All these features, including development and tuning, define what makes one marque different from another.

"Look at how good Honda's shift effort is," Alex Mair points out. "They didn't just design a good shift lever. They designed the whole powertrain as a package. You can't buy an engine from one company, a transmission from another and a clutch from another and get that shift effort."

Faster And Cheaper?

It's only when you get to the things that don't relate to the character of a car, the wheel bearings or the alternator for example, that you can safely outsource the engineering, these experts say. These non-critical items are what Aldikacti calls Public Knowledge.

"Designing the air-conditioning system is Public Knowledge, but deciding if you should have air conditioning, that's Private Knowledge. It's like building a house," he adds. "You tell the builder what you want: Private Knowledge. And he builds it to your specifications: Public Knowledge."

When the top executives at the US automakers explain why they're turning engineering work over to outside firms, invariably the conversation turns to cutting development time and costs. But is it really cheaper to outsource this engineering work?

Anyone who has visited any of the major outside engineering firms that ring Detroit has undoubtedly run across engineers from the Big Three stationed there. Some firms even have reserved parking spaces for these engineers. Oddly, even though these outside firms have been given a job to do, the job just can't seem to get done unless an automaker devotes a small staff to work there. Yet, the cost of this staff is never factored into the outsourcing "savings."

A retrospective look at what Detroit was able to achieve in the past shows that the US industry used to execute programs much more quickly. After all, the US industry used to be famous for its annual styling change. And it used to turn out cars even faster than the Japanese do today.

JAPAN'S ENGINEERING ADVANTAGE

No Wonder Japanese Cars Are So Well Engineered!

COMPANY	ENGINEERS
GM (N.A.)	14,000
FORD (N.A.)	10,000
CHRYSLER	6000
HONDA	12,000
TOYOTA	20,600*
NISSAN	8400*

*Includes subsidiaries
N.A. North America

"The original Corvette took only 12 months from concept to production," notes Alex Mair. "The '55 Chevy took 22 months. The Chevy II, which had four body styles and went into five plants took only 15 months!"

Mair also feels that outsourcing engineering programs could actually hinder a car company from shortening its cycle times. "How will management manage all these outside firms?" Mair asks. "They have to divide their staffs just to monitor the progress of these outside design firms.

"The reason the automakers can't be as fast as they were in the past is that they have too many people not involved in designing and building cars," he explains. "Plus, they have too many meetings and presentations. Why, when I started at General Motors, the only place you were allowed to meet was in the halls! And when Ed Cole was at Chevrolet, he had them re-engineer the escalators so they would go faster."

While the US automakers see outsourcing as the way to get engineering work done faster, cheaper and better, the Japanese automakers seem to think exactly the opposite.

"Consider our basic philosophy: We must always carry our torch by our own hands. We must develop fresh ideas on our own. We must not copy others. We must respect the value of research," says Shoichiro Irimajiri, president of American Honda Manufacturing and designer of some of Honda's most famous racing and production engines.

American executives point out that the Japanese outsource most of the engineering of their components. On a superficial level that's true. But virtually every major Japanese automaker holds equity in its first-tier suppliers. And all of these, in turn, are physically grouped around the automaker they supply. This relationship provides the Japanese automakers with a level of vertical integration that virtually matches GM's.

The Japanese automakers also have more engineers than the American car companies (see chart), which means that they design, in-house, *far more* of the critical factors that define the character of a car.

Recently, Honda developed its own Anti-Lock Brake (ALB) system, even though it could have readily bought an ABS system from Bosch or Teves. And Toyota designed and manufactures the turbocharger used on the Supra Turbo, even though it could have bought it from a handful of other firms.

Obviously, these are items that both Honda and Toyota felt were part of their distinctive character and shouldn't be designed or built on the outside.

Not surprisingly, some industry observers think that the Japanese model indicates what will happen in the US. The need to keep distinct personalties in cars will drive the Big Three to do a better job of what they want up front in the concept stage. And it may well force them to solve their timing and cost problems, rather than managing them through outsourcing.

"In the ultimate, I think this design work will come back in-house," predicts Alex Mair. AI

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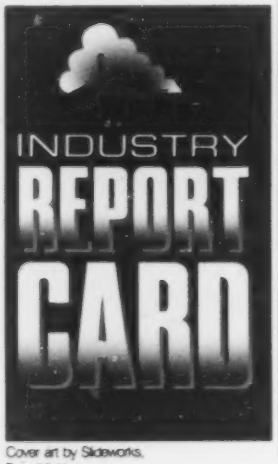

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CHILTON COMPANY, *PART OF CAPITAL CITIES/ABC, INC.*

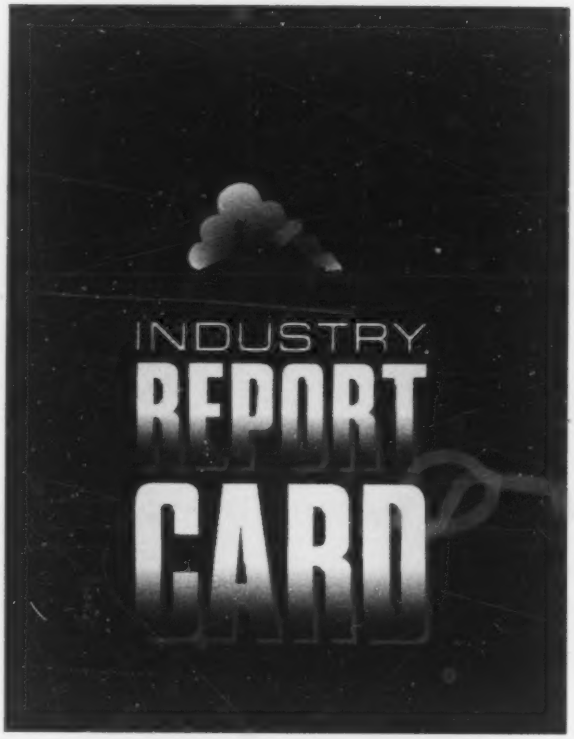
1987 INDUSTRY REPORT CARD

What all the big numbers really mean.

by John McElroy

When future automotive historians look back at 1987, they're likely to note that the year contained a couple of interesting surprises.

First of all, despite two major setbacks, the market showed remarkable resilience. Sales slumped in the first quarter due to the new US tax law that eliminated personal deductions for the sales tax on automobiles. Then, in the fourth quarter, consumer confidence was shaken by the 500-point crash of the New York Stock Exchange on October 18th.



As a result of these setbacks, sales of cars and trucks fell by more than a million units. Nonetheless, at 15.2 million units, it was still the fourth best sales year in history.

One of the other surprises of the year was that imported car sales fell more than domestic car sales, both in total numbers and on a percentage basis. Whereas domestic car sales were down by 532,000 units, imported cars dropped by nearly 650,000 units. And the comparison in the truck market was even more dramatic. Domestic truck sales rose 4.6%, while imported trucks fell 3.5%.

Yet that doesn't mean that all the domestic automakers were successful. To get a true picture, each one must be analyzed on an individual basis. So to put the performance of the Big Three into perspective, *AI* presents the 1987 Industry Report Card.

Under our system, each company is graded according to how it performed in six different categories. Each grade is given based on trendlines that indicate whether or not the company is improving in those categories. We don't compare one company to another. We compare each company against its past efforts, and then we sum it up in an overall grade.

FORD

CATEGORY	1973	1978	1985	1986	1987	GRADE
Quality	--	--	95.3	104.5	101.6	C -
Profit/Unit	$260	$360	$484	$677	$1014	A+
US Market Share	29.8%	26.5%	20.3%	21.2%	23.1%	A
Return On Sales	3.9%	3.7%	4.7%	5.3%	6.4%	A
Productivity	13.7	13.8	16.4	16.8	18.7	A+
Inventory Turns	5.3	6.5	14.1	13.8	15.6	B

OVERALL GRADE: A

Another Ford all-star: New Continental is sold-out through June.

Ford: Best in Class

For the first time since we started the Industry Report Card four years ago, an automaker has earned an overall "A". 1987 will probably be remembered as the Golden Year for the Ford Motor Company. By outearning giant General Motors for the second year in a row, Ford has established itself as the most profitable car company in the world. And it did so with conviction: The company earned a pre-tax profit of nearly $7.4 billion and finished the year with $10 billion in cash and securities on hand.

Perhaps even more remarkable is that Ford's worldwide sales jumped by $9 billion to a total of $71 billion. That means Ford is now ¾ the size of GM. If Ford maintains this rate of increase, it could conceivably surpass GM and become the world's largest automaker, sometime in the early 1990s.

Despite this spectacular financial performance, the company suffered a significant drop in its quality rating, which is based on the J.D. Power Customer Satisfaction Index. The latest CSI is based on data from 1986, which was the first year for the Taurus/Sable, cars which had their share of teething problems.

The people at J.D. Power say the data they're getting now shows that Ford has solved these problems. Still, we graded rather harshly and gave Ford a "C-" in quality performance.

In the profit-per-unit category, which is derived from operating income, Ford's performance was simply spectacular. It earned more than $1000 for every vehicle it sold *worldwide*, which shows that Ford's efficiency stretches around the globe.

What makes this figure even more impressive is that competition in North America forced Ford (and everyone else) to cut prices through rebates and other sales incentives. But even with these price cuts, Ford still made more money than it did last year.

Out in the marketplace, Ford also ran against the trend. Even though the whole American market fell 7.2%, Ford managed to increase total sales by 4.4% and market share by 1.9 percentage points. The fact that an established company the size of Ford could increase share in these conditions earned it a solid "A".

Return On Sales provides a measure of how much money a company is able to keep, compared to the total amount of money it took in. And as the trendlines in the Report Card show, Ford is able to keep more money every year. Why? Because Ford's policy of continuous cost cutting means that it has fewer bills to pay.

The company's Productivity figures show that every year it needs fewer people to build more vehicles. In fact, the latest figures show that Ford's worldwide productivity increased 11.3% last year. And Ford's US hourly employees were able to share in this improvement by earning an average of $3700 in profit sharing.

Ford was also able to increase its Inventory Turns, which shows that the company was running its plants with lower amounts of inventory and more just-in-time production. All this confirms that Ford's manufacturing operations continue to improve every year.

Ford's overall year-to-year improvements are not spectacular. But rather than try to smash a home run every time it gets up to bat, Ford seems content to consistently hit singles. That's continuous improvement.

CHRYSLER

CATEGORY	1973	1978	1985	1986	1987	GRADE
Quality	--	--	77.3	89.6	102.3	A+
Profit/Unit	$127	($129)	$1073	$867	$807	D+
US Market Share	15.6%	11.2%	11.8%	11.7%	12.3%	B-
Return On Sales	2.1%	(1.5%)	12.1%	7.7%	6.2%	D
Productivity	13.0	13.1	19.6	19.6	16.2	D
Inventory Turns	5.6	6.3	18.8	22.1	16.8	F

OVERALL GRADE: C -

AMC/Jeep buy hurt Chrysler's 1987, will help its future.

Chrysler: AMC Was A Mouthful

For the last two years Chrysler had turned in the best Report Card performance. But the latest results seem to show that swallowing and digesting AMC is turning out to be a longer process than even Chrysler's management though it would be. Perhaps next year will yield results that are more positive, but for the time being, Chrysler has got its hands full trying to re-streamline its operations.

Yet, Chrysler deserves to be proud of its Quality rating. The results show that the company continues to get better—and amazingly, Cadillac, Mercury and Lincoln were the only domestic nameplates to finish ahead of Plymouth in the latest Power CSI.

Part of Chrysler's Quality success, of course, relates to the fact that it has been using the same basic platform, engine and underpinnings for eight years. At this point their workers could probably build these cars in their sleep. Chrysler may well find it harder to maintain these quality improvements when it starts to introduce new designs. But that's not to take away anything from its solid "A+" 1987 achievement.

In the Profit-Per-Unit department, Chrysler's trendline is in the wrong direction. That's why we rated it a "D", even though it made more money per vehicle than GM. But Ford easily outearned them both, showing that it is now the low-cost producer in the United States—a distinction it wrestled away from Chrysler. Considering Ford's higher level of in-house component production compared to Chrysler's (50% *vs.* less than 30%), this also suggests that outsourcing is *not* the key to low-cost production.

Part of the decline can be explained by Chrysler's purchase of AMC, which certainly had the effect of raising costs. But it seems to have been mainly due to the extensive sales incentive and rebate programs Chrysler resorted to in 1987. And it's likely that things are going to get worse before they get better. Even though the minivan and Jeep lines are very profitable, Chrysler has recently been forced to offer $2500 rebates on most of its products to cut its high inventory.

Chrysler's improvement in Market Share needs some special explanation. Though the company improved its share in a market that was shrinking, this was mostly due to its acquisition of AMC, not because it sold more vehicles on its own. And though these vehicles were only counted as "Chryslers" after June, this is where the company's increase in market share came from. But an improvement is an improvement—and Chrysler gets a "B".

Chrysler's Return On Sales performance is a reflection of how the company's breakeven point has been on the rise. In other words, Chrysler's costs have been going up faster than it has been able to increase efficiencies.

In 1987, for example, total sales increased by nearly $3.7 billion, yet profits declined by $100 million. That's why we gave Chrysler a "D" in this category, even though it looks very good compared to Ford and GM.

After achieving spectacular improvements in Productivity and Inventory Turns during the early 1980s, the slip Chrysler took in these categories doesn't bode well. But as we have already pointed out, much of Chrysler's 1987 performance was affected by the purchase of AMC. And though this is causing short-term problems, we still see it as a brilliant acquisition that will serve the company well in the long run. Once Chrysler fully digests AMC, *we expect to see it do better again.*

GENERAL MOTORS

CATEGORY	1973	1978	1985	1986	1987	GRADE
Quality	–	–	92.6	92.4	100	B
Profit/Unit	$490	$684	$496	$166	$330	C+
US Market Share	51.5%	47.3%	40.3%	38.4%	34.7%	F
Return On Sales	6.7%	5.5%	4.1%	2.9%	3.5%	C
Productivity	11.4	12.1	12.0	11.7	11.3	D
Inventory Turns	5.4	6.7	11.9	17.4	18.0	A

OVERALL GRADE: C

GM: Turnaround In Sight?

Even though GM didn't turn in a spectacular performance for the 1987 Industry Report Card, it certainly did a whole lot better than in 1986. Perhaps it's overstating the case to say that "the vision is paying off." But the company now has a number of world-class products, including the GM10 cars, the Quad 4 engine and the GMT400 pickup trucks that are catching on in the marketplace. As such, we'll go out on a limb and predict that 1988 will be the General's turnaround year.

Perhaps the best indication of a possible GM turnaround is the improvement it achieved in Quality. For the first time since J.D. Power started its Customer Satisfaction Index, one of GM's divisions – Cadillac – finished in the top 10. And Cadillac came out ahead of all other domestic nameplates, including Lincoln. As a result of this improvement, we awarded GM a "B" for its effort.

We were impressed to see that GM's Profit Per Unit performance was twice what it was last year. But GM still fell short of what it achieved in 1985, and we're grading each company against its own previous efforts. That's why GM only rated a "C+" here.

It's when we turn to US Market Share that GM's biggest problem is evident for all to see. For the last 15 years, GM has been steadily losing share. If the present trendline continues, GM could shrink to Ford's size sometime in the mid-1990s.

The company's market share drop in 1987 of 3.7 percentage points is dangerous. In fact, GM's passenger car sales fell by 1 million units – which is the equivalent of losing Chrysler's entire passenger car operations in the US! As we indicated earlier, we believe GM now has the products coming to turn this situation around. But we feel compelled to give GM an "F" for its effort in 1987.

World-class GM10 cars should fuel the General's resurgence.

GM's Return On Sales improved last year, but we have to question where that improvement came from. For example, GM didn't pay any US income tax in 1987, compared to the $2.7 billion Ford paid in taxes. Then too, the company was able to improve the bottom line by $800 million simply through accounting procedures. Half of GM's profits came from its non-automotive operations even though these only accounted for 22% of total sales.

Indeed, when these accounting procedures and the profits of GMAC, Hughes and EDS are subtracted from the profits GM earned in North America, it turns out the company actually lost $913 million on its automotive operations in the US and Canada. This explains why GM's hourly workforce wasn't given any profit-sharing checks, even though the company reported a total net profit of $3.6 billion.

At first glance, GM's Productivity rating seems hard to explain. After all, the company pared 61,000 autoworkers from its worldwide payrolls in 1987. That alone should have boosted its productivity figures. The problem is that GM's sales have been sliding faster than its headcount, so it hasn't realized an improvement in productivity yet. But this also raises an important point: With the drop in sales, musn't GM reduce its headcount well beyond what it has announced in order to reach the efficiencies it set out to achieve?

If there is one truly bright spot in GM's 1987 Report Card, it comes in its Inventory Turns. Not only does this indicate that GM is running its plants with lower amounts of inventory, a quick comparison shows that it has achieved a best-in-class rating here. AI

CHILTON'S
TRUCK & OFF-HIGHWAY INDUSTRIES

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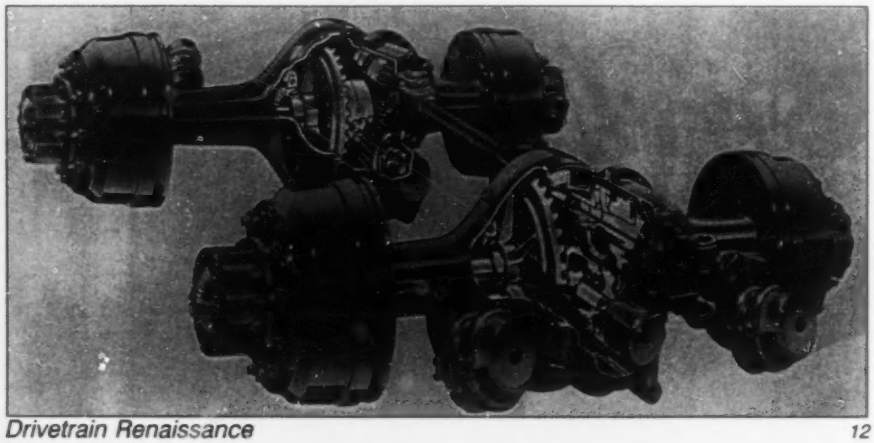

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In June, T&OHI examines trends in HD electronics.

Unscathed by the Crash

by John Stark

The crash of the US stock market might have cleaned the clocks of financial speculators but truck, farm and construction machinery makers are yet to be taken to the cleaners.

When the US stock market fell apart last October 19, apprehension swirled around the truck and off-highway industries about the impending fate of business.

Would unsettled financial markets further weaken consumer confidence and cause panic in the US economy, executives asked?

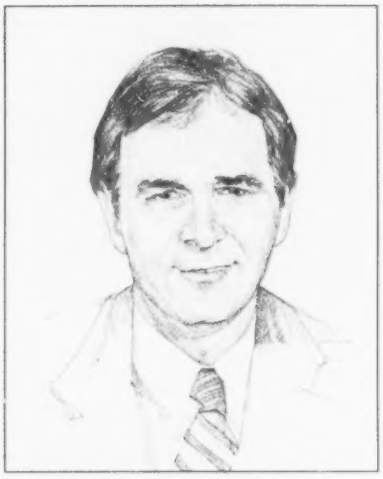
Would a rise in interest rates dry up US housing starts and send light construction machinery into a tailspin?

Would farmers cash in their 1988 payment-in-kind (PIK) federal subsidy certificates early and use the capital to retire debt, rather than invest in new farm equipment?

Would trucking fleets turn to the used truck market at the expense of new truck retail sales?

Economic questions were many and the answers few. Months later, the dust has settled. Truck, farm and construction machinery producers, suppliers and financiers apparently have little reason to be concerned. Business continues abated.

Farm machinery has entered early ascent to cyclical recovery. Trucks and



John Stark is editor and publisher of Stark's Off-Highway Ledger.

construction machinery demand remain at the top end of the current industry cycle.

"The more I look at that crash, the more I'm wondering if it wasn't a very healthy cleanout of an overheated situation," reasons Freightliner chairman Peter E. Rupp. "All in all, it looks like an economy that's living on a good Keynesian recovery trail."

Heavy truck industry statistics appear to bear Rupp out. Backlogs of unfilled orders for new trucks are still rebounding, following a December reprieve. Retail sales declined in January, but are seen as non-consequential due to a rising level of gross order intake, as well as reduced cancellation rates. Hence, vehicle production continues to climb.

In fact, truckmakers are still adding units to their daily assembly schedules. If a slowdown materializes, says Mack chairman John B. Curcio, it might not occur until the fourth quarter of 1988.

The construction machinery business also is enjoying the windfall of peak demand – despite slowdown in US housing starts. Sales have been steadily increasing since December.

Yet, the mix of demand has shifted toward medium and heavy machinery, as export markets benefit from a sharp slide in the value of the US dollar. Light-duty vehicles are falling as US housing starts contract.

Farm machinery business is on the mend too, ending eight straight years of recession. Continuing recovery and a shortage of good used vehicles are responsible for much of the turnaround.

Industry officials see farmers cashing in their PIK certificates in the 1988 first half to buy new tractors. Rising self-propelled combine sales this fall should enable the industry to register its first year-to-year gain in actual unit turnover since 1979.■

US TRUCK AND OFF-HIGHWAY BUSINESS AFTER THE CRASH

TRUCKS

	Oct. '87	% Change Year Ago	Nov. '87	% Change Year Ago	Dec. '87	% Change Year Ago	Jan '88	% Change Year Ago
Class 1-2	311,670	+11.3	304,999	+21.2	327,980	-00.9	288,989	+28.5
Class 3-7	14,032	+06.7	13,893	+34.4	15,972	+12.7	12,871	+11.3
Class 8	12,056	+12.0	10,074	+18.5	11,374	+03.7	9,414	+18.4
Total	337,757	+11.1	328,966	+21.7	355,326	-00.2	311,274	+27.3

CONSTRUCTION EQUIPMENT

	Oct. '87	Change Year Ago	Nov. '87	% Change Year Ago	Dec. '87	% Change Year Ago	Jan '88	% Change Year Ago
Crawlers	1,100	+18.3	1,110	+08.7	1,880	+11.9	1,150	+119.
Wheel Loaders	700	+23.9	805	-00.6	1,000	-04.8	700	+97.2
Ind Wheel Trctr	2,405	-08.0	2,460	-13.5	3,225	-05.1	1,350	+13.9
Skid Steer Ldrs	1,740	+23.4	1,650	+20.9	2,015	+04.7	1,265	+47.9
Log Skidders	240	+33.3	205	+32.2	290	+65.7	190	+02.7
Total	6,185	+08.5	6,230	+00.7	8,410	+02.2	4,655	+49.9

A Class 8 COE Resurgence

by Douglas Williams

For years, industry watchers have said that if the taxes and road rules for big trucks were more logical, sales of cabover-engine tractors would suffer dramatically. One recent piece of legislation, the Surface Transportation Act of 1983, removed most of the restrictions regarding overall length in tractor-trailer rigs, causing many to predict the demise of the COE.

It didn't quite work out that way. In fact, many in the industry are pleasantly surprised that COE sales have hung on and may even grow somewhat in coming years.

At Volvo GM Heavy Truck, product planning manager Brian Wheeler says his company is looking for sales of cabovers to reverse the trend of recent years.

Where COEs peaked at 42% of the market in 1982 and then fell steadily—to 40% in 1984, then to 25.5% in 1096, then to about 17% last year—Volvo GM today expects to see the cabover share rise initially, and then flatten out.

"We now expect this trend [to falling market share by cabovers] to reverse, with sales reaching approximately 22% in 1992," Wheeler says.

He cites two main reasons. First, the design changes going into cabovers—such as set-back front axles for better maneuverability, cab instep and improved aerodynamics.

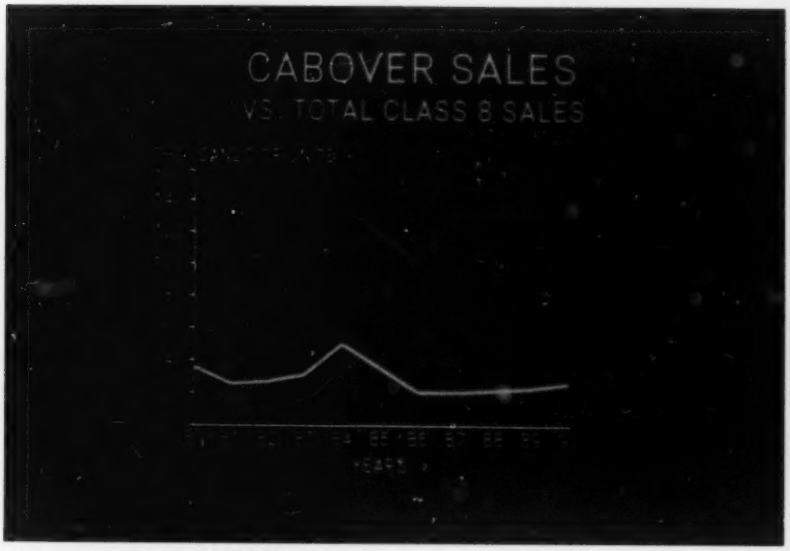
Secondly, Wheeler notes the 53-ft long semi-trailer is gaining in popularity. Currently it accounts for less than 5% of van trailer sales, he says. But sales of that long trailer are going to increase, he argues.

"Currently, 31 states allow practical application of 53-ft semis on interstate roads either by regulation or permit," adds Wheeler.

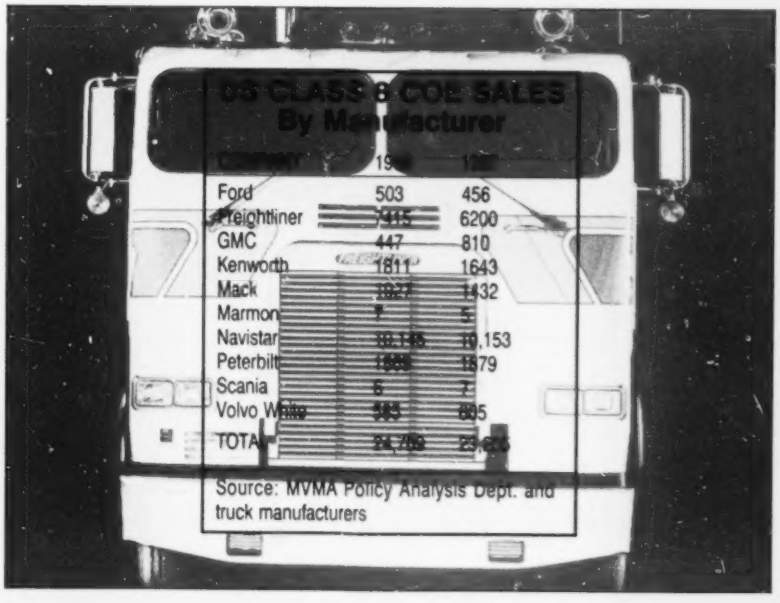
Accomodating the 53-footer or pulling double-bottoms is boosting sales of Navistar's 9700 series COE, notes spokesman John McDonald, particularly models equipped with the set-back-front axle.

McDonald says the cabover is gaining back some of its past appeal to truck operators. He explains that in order for shippers to gain a bigger cube, they need the longer trailer.

Just a few years ago, conventional wisdom held that if those overall limits on truck length didn't exist, conventionals would overwhelm the industry. Now the inherent design advantages of those 'two-story trucks' are giving new enthusiasm to the Class 8 truckmakers. Indeed, the predicted demise of the big COE has been greatly exaggerated.■



*Sales estimates, 1988-90



Early Look: GMC's Next Medium

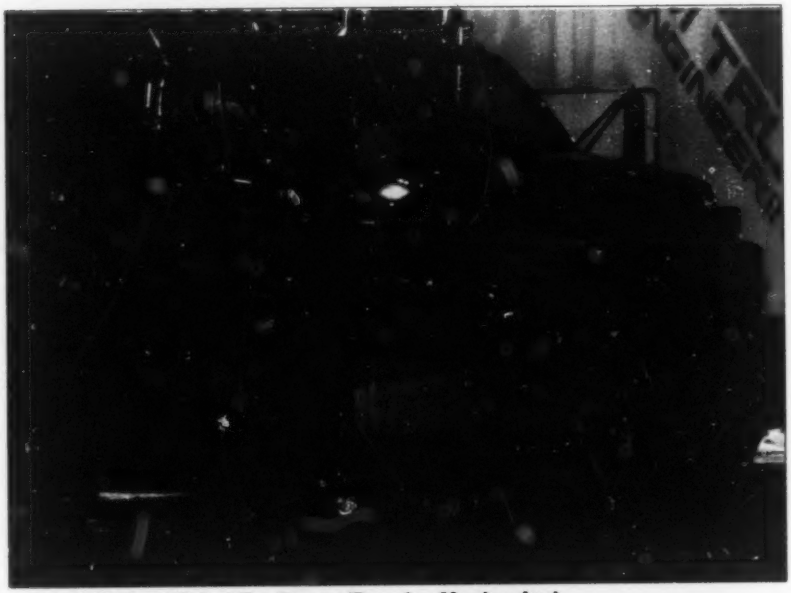
by Douglas Williams

General Motors' next major medium truck model change, coming with the 1990 conventional-cab medium series, will be carrying the softer, rounder lines of the current GMT400-series full-size pickups. This comes at a time when those same styling lines are being blamed in part for the GMT400s' relatively sluggish sales performance.

The second point of interest on the new mediums is that they'll be powered with Caterpillar's 3116 diesel engines, a fact much applauded at Cat headquarters in Peoria. A large product line offering like the GM mediums goes a long way toward getting the base volume needed to make a new engine an economic success.

The medium trucks, Chevrolet's Kodiak and GMC's Top Kick, are widely used for school bus, construction and delivery applications.

In addition to the new Cat diesel, GM will continue to offer the mediums with its Detroit Diesel 8.2-L diesel and three gasoline V8 engines, from 5.7-L to 7.0-L.



1989 GMC Top Kick. (Jim Dunne/Popular Mechanics)

Plastic Body Panels?

The Cat diesel is called the 3116 because it displaces 1.1-L per cylinder—or 6.6-L total displacement in the standard six-cylinder configuration. It's considered a state-of-the-art engine—certainly one of the reasons GM selected it for OE application.

Tom McDaniel, director of medium truck operations at GM Truck, said the new Cat engine will be rated from 165- to 250-hp in the new mediums.

Launched last year, the 3116 is now used in a Cat excavator and will appear in other Cat construction equipment this year. The engine is also part of what Caterpillar considers a major marketing thrust towards "the price competitive standby power market" for power generation that the company began last year.

Cat's engine people are touchy about public talk relating to the 3116 for an obvious reason: Such talk quickly involves the aging 3408 engine, whose future looks relatively incompatible with the 3116.

The accompanying spy photo shows the rounded edges on the new trucks' front ends. Doors wrap higher into the roofs, and the windshield has a more substantial slant than previous medium trucks.

There are reports, as yet unsubstantiated, that the new GM medium truck will incorporate major body panels made from plastic.

GM is trying to commonize as many parts, particularly cab parts, between the Top Kick/Kodiak and the GMT400 pickups as possible. Medium truck instrument panels have long been unique, for example; the cab and IP in the GMT400 pickup are fully adequate for medium truck uses.

GMC is currently testing the new truck against the F-700 Ford and Navistar 1600. Medium trucks, once the critical part of the truck business, have been eclipsed by Class 8s over the past two decades. The business is traditionally split by Ford, General Motors and Navistar where the three typically take over 90%.

For years they've split the business into nearly indistinguishable thirds, trading first place on a regular basis, with no one successful in establishing a dominant position.

Imports have yet to make major inroads into the medium market, despite serious efforts by Iveco, Mercedes, Nissan and others. Ironically, the offshore successes in medium American trucks have been through the three domestics.

GM is selling some medium Isuzu trucks, and Navistar a variety of Nissans. Both truck lines wear the badges of the US companies. Ford is banking on its Cargo-series trucks, made in Brazil but with US-made major components.■

MEDIUM TRUCK SALES
Classes 4,5,6,7*

COMPANY	1986	1987
Navistar	44,700	43,800
Ford	45,300	42,700
GMC	34,500	31,200
Mercedes-Benz	4000	3800
Hino	1050	2000
Nissan Diesel	725	1700
Volvo	1450	1675
Iveco	--	780
Mitsubishi Fuso	--	750
Isuzu	6	550
Kenworth[1]	--	210
Peterbilt[1]	--	200
1987 TOTAL		150,465

*GVW 14,001-32,999 lb.
[1]Built by VW do Brasil

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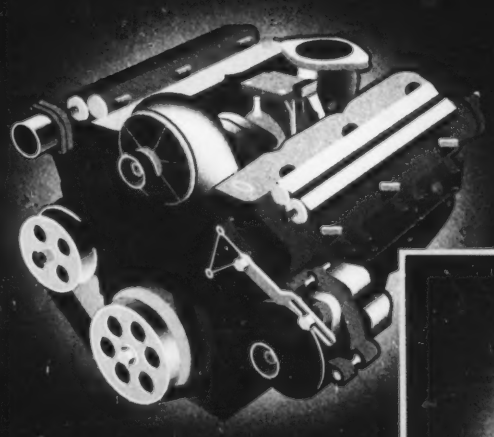
To Stroke...Or Not TWO STROKE?



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CHILTON COMPANY, *PART OF CAPITAL CITIES/ABC, INC.*

AUTOMAKER QUARTERLY REPORT

A golden opportunity for Big Three market share gains.

by Dr. Thomas O'Grady

Domestic automakers now have a perfect opportunity to reclaim some of their market share lost to the Japanese. As the US automotive market expanded during the first quarter of 1988—with a 13.7% increase in sales volume over first quarter 1987—sales of US-produced passenger cars were up 14% during the first quarter over the same 1987 period. While several Japanese manufacturers raised their base prices in response to the weak dollar, the domestics have so far avoided 1988 model price increases.

Ford's first quarter share of the total industry increased almost 2.5 percentage points over its 1987 share. GM gained almost .75 percentage points and Chrysler's share rose about 1.3 points from 1987 levels.

The strong domestics are currently showing some influence on Japanese market share—witness the absence of the Toyota Camry and Nissan Sentra from the Top Ten list this quarter. Honda's percent of the industry fell from 7.3% during calendar year 1987 to 6.6% in first quarter 1988. Although its volume has improved, Toyota's share dropped to 5.3% this period. Nissan lost nearly 24% of US sales in the first quarter; its share is now 4.1%.

Dr. Thomas O'Grady heads Integrated Automotive Resources, Inc. in Wayne, Pennsylvania.

Nissan aside, the losses in market share among Japanese imports are surprisingly minor, considering unfavorable exchange rates and rising prices. However, some of the larger companies may lose some VRA allocation to smaller automakers like Mitsubishi, Isuzu and Suzuki.

Most of the European manufacturers are finding it more difficult to adjust to rising prices. Mercedes-Benz first quarter sales were down 14.1% compared to the same 1987 period; BMW lost 14.6% of their sales. Porsche first-quarter sales fell 24.5% this year—a dangerous drop for a very low-volume manufacturer. AI

WHAT'S HOT!
US Auto Sales
(1st Quarter Results)

Carline	'88	'87	% Change
Taurus	101,901	78,535	29.75%
Corsica/ Beretta	101,120	12,579	--
Escort	92,059	84,561	8.87%
Accord*	78,061	72,227	8.08%
Tempo	72,250	60,821	18.79%
Cavalier	71,347	95,210	(25.06%)
Celebrity	71,228	85,642	(16.76%)
Excel	71,026	56,164	26.46%
Grand Am	60,204	50,691	18.77%
Ciera	59,451	62,584	(5.01%)

*—Includes imports
( )—Negative value

US Passenger Car Market Shares 1st Qtr '88

Manufacturer	Sales	% Total
General Motors	987,944	37.35%
Ford	573,874	21.70%
Chrysler	319,400	12.08%
Honda/Acura	174,501	6.60%
Toyota	139,988	5.29%
Nissan	109,338	4.13%
Hyundai	71,026	2.69%
Mazda	64,820	2.45%
VW	46,791	1.77%
Subaru	36,498	1.38%
Total	2,524,178	

(Continued)

Passenger Car Market Share By Geographic Base

First Quarter 1988

Manufacturers	Total Sales	Total Market Share
American	1,738,206	65.72%
Japanese	482,436	18.24%
European	128,527	4.86%
US Built Imports (VWUS, Honda, NUMMI, Nissan, Mazda)	175,820	6.65%
Other Imports (Excel, Festiva, Fox, LeMans, Precis)	119,833	4.53%
Total	**2,644,822**	**100.00%**

FIRST QUARTER DOMESTIC LIGHT TRUCK PRODUCTION

COMPANY	FULL-SIZE TRUCKS	COMPACT TRUCKS	FULL-SIZE VANS	COMPACT VANS	FULL-SIZE SPORTS UTILITY	COMPACT SPORTS UTILITY	TOTAL 1988	TOTAL 1987
FORD	177,638	93,982	65,736	59,052	16,120	39,029	451,557	428,358
CHEVROLET	121,936	66,528	34,661	45,058	35,424	39,270	342,827	329,505
GMC	47,571*	18,897	19,274	11,616	12,897*	10,001	119,856	97,082
CHRYSLER	15,087	30,073	20,858	131,953	4337	–	202,938	181,955
JEEP	–	12,533	–	–	3503	62,289	78,325	53,218
NISSAN	–	33,613	–	–	–	–	33,613	21,569

*Includes Suburban and P-model

C2150-3

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DASHBOARD DOGFIGHTS!

HEAD-UP DISPLAY IS HERE

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Gerry Giovinco of ECW, Audubon, PA penned the cover. Heads-up readers will recognize the twin-tailed bogey as Mikoyan-Gurevich's MiG-29 Fulcrum.

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OVERSTOCKED AND OUTCLASSED

Despite gains, the Big Three still lag the Japanese in inventory control.

by John McElroy

Though the US automakers have been involved in a concerted effort to cut costs since 1981, they are still high-cost producers compared to their Japanese competitors. And this is especially true in the area of inventory control.

If General Motors were able to control its inventory as efficiently as Toyota does, for example, it could free up several billion dollars that it now has tied up in work-in-process, raw materials and supplies. Ford and Chrysler also have billions more tied up in inventory than do their Japanese competitors.

Inventory represents the money that must be invested to buy all the parts and materials that are used to make a car or truck. Companies that can operate with lower levels of inventory thus free up money that can be invested elsewhere.

To their credit, the American automakers have made significant improvements in reducing the inventory at their vehicle assembly plants. In the early part of this decade, for example, a typical US automotive assembly plant could muster only 10 to 20 inventory turns a year.

Today, there are numerous plants that achieve between 80 and 100 turns a year, which is not far off the 125 turns a year that world-class assembly plants achieve. Yet, the five- to 10-fold improvement that the Big Three have achieved in their assembly plants has not been matched elsewhere in their manufacturing operations.

Amongst the Big Three, General Motors now has the lowest inventory investment per car. And considering GM's high level of in-house parts production, its achievement is even more impressive when compared to Ford and Chrysler, which are far less vertically integrated.

INVENTORY INVESTMENT PER CAR

Company	1981	1982	1983	1984	1985	1986	1987
General Motors	$674	$604	$540	$637	$600	$471	$499
Ford	$580	$543	$498	$437	$475	$543	$535
Chrysler	$626	$550	$564	$525	$429	$374	$550
Toyota	$ 54	$ 56	$ 57	$ 62	$ 50	$ 56	$ 77
Mazda	$ 58	$ 77	$ 75	$ 72	$ 87	$ 82	$ 88
Honda	$110	$100	$104	$121	$146	$165	$150
Nissan	$111	$204	$195	$204	$226	$225	$202

Until 1986 Chrysler had achieved the best improvement in inventory reduction. But it seems that the company's acquisition of inefficient American Motors undid much of its previous hard work in this area.

Oddly, the Ford Motor Company, which is often perceived as the most efficient US automaker, has made little headway in improving its inventory management. Apparently, the company still prefers to operate with large production runs, as opposed to the Just-in-time production methods of its Japanese competitors.

> Oddly, Ford—which is often perceived as the most efficient US automaker—has made little headway in improving its inventory management.

Yet even the Japanese cannot be all that sanguine about the trendlines. A glance at the accompanying chart shows that Japanese inventory costs have been rising throughout the decade. Indeed, though Toyota remains the most efficient automaker in inventory control, its inventory costs rose nearly 40% last year.

As the Japanese automakers begin to build larger cars with more content—and higher cost content at that—their inventory costs have gone up. And as the Japanese automakers build more plants overseas, they will be hard pressed to maintain the tightly knit JIT system they have developed in their home market, where their suppliers are clustered around their assembly plants.

But for the time being at least, Japanese automakers still have far less money invested in inventory—money that has been invested elsewhere in far more profitable ventures, such as in new, upscale car programs (Acura, Lexus, Infiniti) or in new areas of technology (four-wheel steering, multivalve engines and four-wheel-drive). Better inventory management could help provide US automakers with capital for its own future product development programs.

For all the improvements the Americans have made, the Japanese remain—for the time being, at least—the industry's best inventory managers. They're still the target at which their American competitors must shoot. AI

CAPITAL PERFORMANCE!

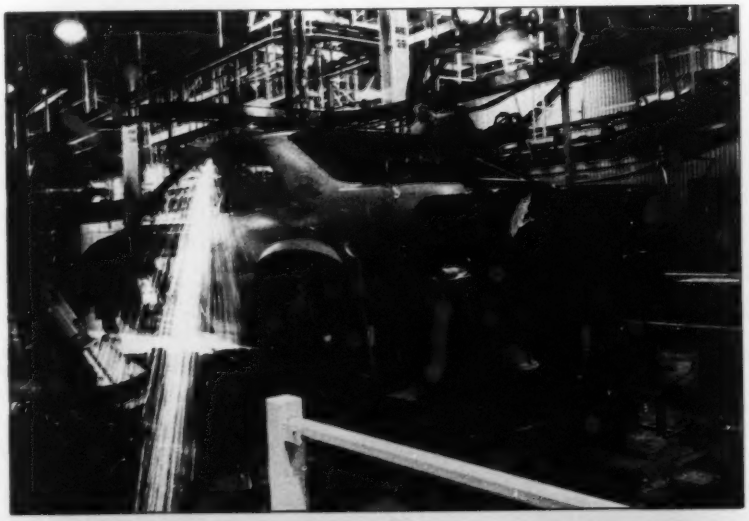
Mazda Flat Rock versus GM Fairfax: Does a billion bucks mean better efficiency?

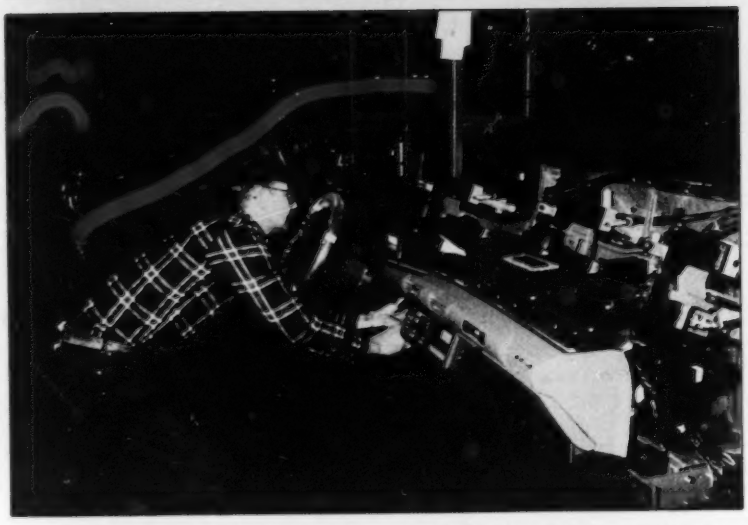
by Gerry Kobe

"World-class efficiency" has become a buzz-phrase among automakers. The critical element, however, to actually earning that title is the ability to withstand the 'trial by fire' of direct comparison. Recently we've had the opportunity to tour the latest manufacturing plants of GM (Fairfax, Kansas) and Mazda (Flat Rock, Michigan). By way of comparison, these are the latest entries in the race for automaking efficiency.

GM's Fairfax plant is a modern, high-tech replacement for the now-idle facility that stands in its shadow. The original plant was constructed to build B-25s during World War II, and during the '50s it simultaneously produced 600 F-84 jet fighters and 70,000 cars a year! But age and an inefficient floorplan mandated that GM start with a clean slate, and the decision was made to build an all-new facility.

To help attain their "world-class" goal, GM sought the input of an often overlooked resource—its workers. It was, in fact, input from the Fairfax rank-and-file that helped determine the layout of the assembly process. Furthering that hands-on approach, the plant also adopted a "team concept," whereby groups of up to ten people are trained to perform each others' jobs. The group then regulates itself as to rotation of duties and even build sequence in order to maintain high worker interest and productivity levels.





C-P-C Fairfax is dedicated to Pontiac Grand Prix (top), claims world's best floor space utilization. Worker ergonomics lag in some areas.

Kaisen In Action

At Mazda, "team concept" takes on a much more comprehensive meaning. This facility exudes the idea of involvement by centrally locating the administrative area. Notice that the word "area" is used instead of offices, for indeed there are no private offices to detract from the feeling of open communications. The plant manager and other top executives are center-stage in a large room that also houses the plant's control room. When high-level meetings take place, they do so in glass-enclosed meeting rooms.

Teamwork at Mazda begins with a six-week training period. During that time, new employees are familiarized with the entire assembly process as well as the Japanese process of *kaisen*, or continuous improvement. Flat Rock workers are also trained to do time-and-motion studies, which document the effectiveness of new ideas that workers (with the help of manufacturing engineers) implement at their station.

Flat Rock builds MX-6 and Probe, employs Japanese kaisen process.

GM may encourage worker involvement, but at Mazda there is *evidence* of it everywhere. In one brilliant example, a wheeled parts tray has been placed on a long inclined table directly beneath the path of the conveyor. As the car enters the work station it catches a spring arm on the top of the parts tray which pushes it at line speed, up the table top where it is most convenient for the workers. When the tray gets to the end of its travel, the spring-arm bends and allows the tray to slide back down the incline and into position for the next vehicle. Many other worker-inspired ideas adorn the plant, but the message is always the same: Teamwork is not a concept at Mazda; it's a way of life.

Dave Campbell, director of manufacturing at C-P-C, is quick to point out that Fairfax has the best-in-class space utilization of any auto plant in the world. At only 2.2 million ft^2 (including on-site stamping), the facility produces the most cars in the smallest floorspace. Contributing to this achievement is the omission of storage areas in favor of receiving docks.

Just-in-time delivery makes good use of these 42 docks by staging incoming parts within 350 ft of their intended use. Part-mix is also held to a minimum by committing only one model, the Pontiac Grand Prix, to the plant.

PLANT PLAYOFF!
The faceoff between Fairfax and Flat Rock

	FAIRFAX	FLAT ROCK
Products	Grand Prix	MX-6, Ford Probe
Investment	$1,050,000,000	$550,000,000
Plant Size	2.2 million ft^2	2.7 million ft^2
Line Speed	66 cars/hour (est)	68 cars/hour
Capacity	232,000 units/year	240,000 units/year
Total Robots	242	350
Employment	3770 hourly	2800 hourly
	430 salary	300 salary
	4100 total	3100 total
Man Hours/Car	30	22

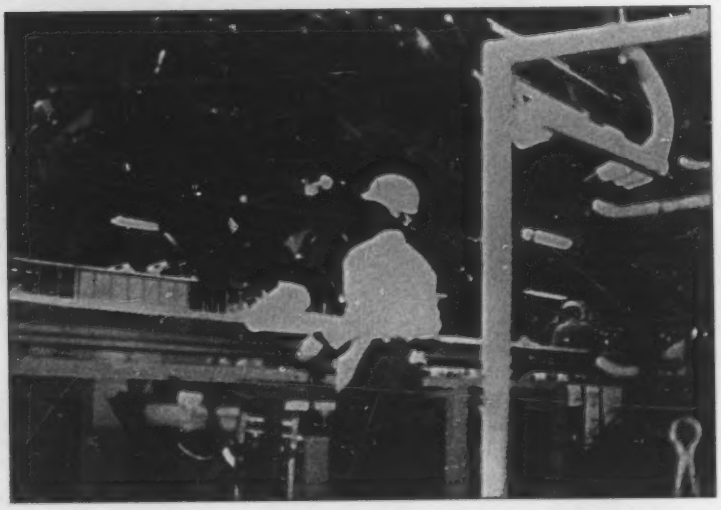
The Bottom Line

At Flat Rock, the 2.7 million ft^2 of building space houses not only an on-site stamping facility, but also a plastics shop which operates six injection molding machines. In addition, the Mazda plant also includes a large material handling center where incoming imported components are removed from their shipping containers, and assembled into modules.

Nonetheless, these extra operations still don't explain why Mazda needs 500,000 more ft^2 of floor space to build roughly the same number of cars that Fairfax does. But maybe this is a hint of things to come. We've heard rumors that Mazda may push production at Flat Rock to 300,000 cars a year.

The use of AGVs is much different

At Flat Rock, evidence of worker involvement is everywhere.



Mazda may up production to 300,000 units/year, eating up extra floor space.

in each of the plants, with Fairfax demonstrating their greatest potential. Mazda uses the vehicles mainly to deliver blanks to the press lines, while GM employs them to move vehicles through the body shop. The extensive use of AGVs at Fairfax allows GM to take advantage of their flexibility to maneuver vehicles into tight spaces that conveyors would not allow.

If efficiency were achieved by robots alone, Mazda would have it in spades, with an unbelievable 276 robots in the body shop alone! Fairfax, in contrast, has a total of 242 for the entire operation, while Mazda boasts a total of 350. Flat Rock also builds the front suspension and drivetrain as a module and then automatically installs it with the help of video cameras and robots. Rear suspension, windshield and backlight are installed in like manner.

Worker ergonomics is one of those areas in which you can only observe and speculate, but the logistics that have been employed at Mazda seem to have escaped the engineers from GM. Watching Fairfax workers hold wrenches over their heads as they try to bolt down suspension parts is enough to evoke compassion in the coldest of hearts.

Their counterparts at Mazda however, work at chest level as the conveyor dips and tilts the car for their comfort. It doesn't seem a lot to ask.

Like all comparisons however, the important thing is the bottom line, and it is here that the two plants seem to go their separate ways. Flat Rock with a capacity of about 240,000 units per year was built at a cost of about $550 million (at 1985 exchange rates).

Even at current exchange rates, the cost of the Flat Rock plant "only" comes to about $820 million, whereas Fairfax, with a capacity of about 232,000 units per year, was built at a cost of over one billion dollars! And yet, as noted above, the Mazda plant is 500,000 ft^2 larger.

The investment in the plant and the payroll are the figures that have the most important impact on the bottom line. They help determine the profit margins for the automaker. Mazda could end up getting a lot more out of its investment: the Flat Rock workforce numbers 3100, while Fairfax employs a total of 4100 workers. (That number may change; at press time, GM announced it would cut Fairfax line speed from 75 cars/hour to 50/hour, resulting in the the possible layoff of 600-900 workers.) We wonder why Mazda needs 1000 fewer employees for roughly the same output.

We can't knock GM for the advancements they've made, because they've come too far for that. Quality is up, productivity is up, the product is very competitive and the prices are right. Proportionately, they have come further, faster than the Japanese.

But the Japanese are moving too, and all GM has done is cut the rate at which their competition is pulling away. If GM wants to *overtake* the Japanese in manufacturing efficiency, its first step should be to admit that the other guys are still ahead. AI

1988 Ignites Ag Demand

by John Stark

Euphoria is rampant throughout the North American farm machinery industry, as sales of farm tractors and self-propelled combines continue to skyrocket. Manufacturers appear readily anxious to put an end to eight unprecedented years of back-to-back falloff of US and Canadian market demand for their machines (see *Snapshot* page for tractor and combine sales charts).

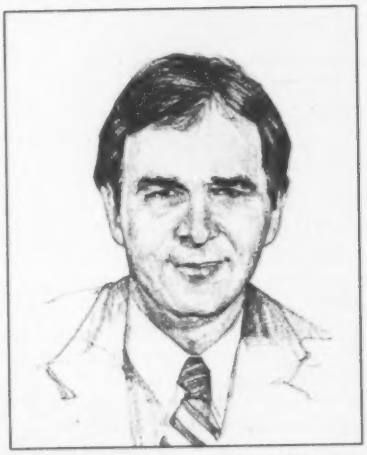
Industry officials are convinced, and rightly so, that turnaround is inevitable. However, some firms could be going overboard on optimistic outlooks. Several farm machinery managers warn that planned production scheduling hikes of 30% or more at local factories, to accommodate similar rises in demand, might unexpectedly backfire.

If the fast pace of tractor sales, as expected, slows down this summer and early fall, inventories of new two-wheel-drive tractors with 100 hp or more could start to bulge on dealer lots once again—prompting a return to major tractor price-cutting programs in late 1988 or early 1989.

Turnaround in demand for new high horsepower tractors ignited in the 1988 first quarter, when Case/IH slashed prices by up to 60% in the 1987 fourth quarter to rid themselves of excessive dealer inventories.

Price discounting has remained low for high-horsepower farm tractors since the start of this year. New vehicle stocks are "extremely tight" at most Deere and Case dealerships.

Inventories of 30-99 hp dairy-type tractors are also low, a result of early



John Stark is editor and publisher of Stark's Off-Highway Ledger.

1987 drawdown on good used tractor stocks and return of buyers to the new vehicle market.

Favorable fundamental market conditions also continue to multiply throughout the business, prompting little risk of inventory buildup.

US buildup and Canadian sales of 2WD tractors with 100 hp or more exploded by 101½% during the first three months of 1988. Prices paid to farmers for soybeans are at their highest level in several years.

Sale of 40-99 hp 2WD farm tractors also soared 32.4% in the same period as cattle prices continue to improve for most farmers.

Poultry prices are also rising dramatically for many farmers in Maryland and the southern and southeastern parts of the US. It's a pleasant relief for farmers hard-pressed after eight straight years of failing business and a surprise for farm machinery OEMs. They fully expected poultry activity to expand at the expense of cattle (red meat) operations.

Dry weather has taken over much of the Plains States and Western Canada. It will undoubtedly delay plantings of corn and wheat. Subsequently, large tractor and combine sales should continue to grow in the coming months as farmers scramble to sow their crops when weather conditions improve.

Four-wheel-drive tractor sales went up 70% in the first quarter of this year and combines leaped ahead by 300%, as farmers attempted to beat the recent increase of interest rates by buying machines earlier than planned.

What's unclear is this: Did rising interest rates actually pull sales of 4WD tractors and combines ahead by three to six months? Or did they pull marginal buyers back into the market?

Nonetheless, interest rate hikes are seen by several farm machinery firms as having a favorable impact on business activity by inflating prices for commodities and improving cash flow.

Farmers, they note, have historically elected to re-enter the farm machinery market to purchase new vehicles when cash flow is at its highest.

Farm machinery manufacturers are currently gearing up for major increases in production of tractors and combines, to fill the market void.

However, the euphoria might be overstated. More substantial growth in cyclical market demand is seen materializing next year.■

AG EQUIPMENT ON THE REBOUND!

TRACTOR AND COMBINE SALES

	1988 1st Qtr.	*% Change Year Ago*	*1987 4th Qtr.*	*% Change Year Ago*	*1987 3rd Qtr.*	*% Change Year Ago*	*1987 2nd Qtr.*	*% Change Year Ago*
0-43hp	11,065	-00.4	12,555	-05.1	15,650	+04.9	25,420	-02.4
40-99hp	9610	+32.4	11,330	+05.1	9105	+00.6	12,060	-04.2
100+hp	4665	+101.5	5420	+21.1	7995	+289	3920	-48.4
All4WDs	935	+70.0	1075	-13.3	455	-27.2	555	-37.3
TtlTrac.	25,275	+23.7	38,330	+02.2	33,205	+25.1	41,325	-09.9
SPComb	1580	+320.0	4020	+19.1	3530	-29.4	760	-21.2
Total	27,855	+28.8	34,400	+03.9	36,735	+16.1	42,085	-10.2

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What's new in Parts and Components for '89? Blowers, six-cog trannies and more! Feature begins on page 34.

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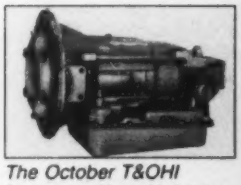

The October T&OHI features New Vehicles, Parts and Components

The Drought And Ag Equipment Sales

by John Stark

Drought in the Northern Plains, the Corn Belt and Delta regions of the US, as well as in western Canada, is starting to worry the North American farm machinery business. Farmers are worried that, if dry weather continues, corn and wheat crops will be destroyed, while soybean yields might plummet too.

Ag equipment makers are worried that, if dry weather persists, sales of highly profitable large two- and four-wheel-drive farm tractors and self-propelled combines might wither in the 1988 second half.

The drought could also further erode feed grain yields. Prices may climb even more, prompting cattle farmers to liquidate their herds as economic operating conditions turn sour. It could gut further turnaround in the smaller 40-99 hp segment of the two-wheel-drive tractor business.

The North American farm machinery business had been staging an impressive comeback during the first half of this year, following eight straight years of disappointing market developments. Overall unit volume is up nearly 14%. Manufacturers had been expecting all along that vehicle sales would be down in the second half, due to strong year-ago turnover fueled by major tractor price cutting at Case/IH and John Deere.

Farm machinery officials believe the economic impact of the drought has been overstated. Corn yields could be

John Stark is editor and publisher of Stark's Off-Highway Ledger.

off 25%; wheat might be down 10% and soybeans could escape. Soaring prices for the salvaged crops, idle acreage now freed for plantings of hardier crops and Federal drought aid will likely offset much of the adverse impact from drops in yields, netting little slowdown in spending by farmers for new machines.

As US agricultural exports advance 20% in 1988, to $33.5 billion – the highest level since 1984 – farm debt falls another 5.5% and debt-to-equity ratios narrow, the value of an average acre of farmland should go up 3.1%, ending a five-year freefall.

It represents a significant development. Real estate assets, seen rising 1% this year, are used by many farmers as collateral for machinery loans.

Even though farm machinery sales during the first half of 1988 jumped 14% ahead of last year, it will no doubt falter in the second half, netting 3% overall gain. This is in line with the 1% gain seen for farm real estate assets and indicates pent-up demand for farm vehicles still abounds.

Consequently, drought may bottle up pent-up demand for the remainder of this year. But the upshot is this: The 1989 and, more likely, 1990 years could explode into periods of fast-paced recovery. Interestingly, some ag machinery industry managers see vehicle demand in 1990 approaching the record levels of 1979!

Deere appears ready to enter the high growth period of the 1990s from a position of superiority, after consolidating its leadership role in 1987. Ford New Holland could offer Deere its most serious threat. Ford overtook Case and Kubota last year, as Kubota's US and Canadian market penetration fell victim to the soaring yen. But that may be remedied next year when Kubota opens an implement manufacturing site in the US.

Weaker competitors tail the Big Four (Deere, Ford, Case and Kubota). They include Massey Ferguson, Deutz Allis, White-New Idea Farm Equipment and the bankrupt Massey Combines. Time will tell where these lower volume sellers will fit into future business activity.■

US FARMLAND VALUES BY REGION, BY ACRE

REGION	*Feb.'88*	*% Change*	*Feb.'87*	*% Change*	*Feb.'86*	*Apr.'84*	*Apr.'82*
Northeast	$1474	+08.7	$1602	+13.5	$1416	$1414	$1364
Lake States	$639	+06.9	$598	-14.8	$702	$1099	$1234
Corn Belt	$888	-09.0	$815	-09.7	$903	$1414	$1642
Northern Plains	$306	+07.0	$286	+11.5	$323	$499	$547
Appalachia	$972	+02.2	$951	-03.3	$983	$1090	$1083
Southeast	$1056	+05.6	$1000	+00.1	$999	$1094	$1095
Delta	$665	-00.2	$666	-16.4	$797	$1040	$1135
Southern Plains	$457	-03.0	$471	-11.0	$529	$614	$576
Mountain	$227	-02.6	$233	-05.7	$247	$319	$325
Pacific	$951	-02.4	$974	-12.0	$1107	$1361	$1346
Total (48 States)	$564	+03.1	$547	-08.1	$595	$782	$823

Note: Data represents average US dollar value/acre of farmland and buildings.

AUTOMAKER QUARTERLY REPORT

Domestics flex their muscles in the second quarter.

by Dr. Thomas O'Grady

After three consecutive years of decline, the domestic share of the US passenger car market may rise for the 1988 calendar year. Second quarter sales results show the strength of the domestics this year: a 64.4% share versus 64.0% during the second quarter of 1987 and 62.5% for *all* of 1987.

The weak dollar and competitive markets restricted sales of some traditional imports. Market share of Japanese-built models during the second quarter was approximately the same as one year ago. Price increases hurt the Europeans, especially in the luxury arena—their share dropped from 6.4% in 1987 to 4.7% this quarter.

GM's total corporate share is down for the quarter, but it can regain some of '87's lost share if it has a good second half this year.

Ford's exciting new products are now paying off in market share. And Chrysler gained nearly one point of share from second quarter '87.

Dr. Thomas O'Grady heads Integrated Automotive Resources, Inc. in Wayne, Pennsylvania.

Honda and Toyota saw profitable second quarters, but Nissan sales were down. Most of the smaller Japanese companies suffered losses as a result of price increases and strong domestic sales. Mazda, however, increased its share from 1.8% in the second quarter of 1987 to 2.3% this period with new introductions. And Korea's Hyundai increased it's share of the market rather modestly.

GM, with its C/K series and Chrysler are likely to be the winners in the light truck market this year. GM's overall share of that market rose from 30.9% in the second quarter of 1987 to 34.1% in 1988. Ford's share dropped from 30.1% to 30.0% during the same period. The Chrysler/Jeep share rose from 20.0% in the second quarter of 1987 to 22.2% for the same period 1988. The Japanese share of light truck markets fell from 18.8% in the second quarter of 1987 to 16.6%. AI

WHAT'S HOT! US Auto Sales (2nd Quarter Results)

Carline	'88	'87	% Change
Corsica/ Beretta	121,394	64,327	88.71%
Taurus	109,072	96,445	13.09%
Escort	100,012	107,031	(6.56%)
Accord*	94,606	76,961	22.93%
Cavalier	85,508	71,655	19.33%
Excel	77,467	70,892	9.27%
Tempo	74,838	65,284	14.63%
Grand Am	67,556	60,970	10.80%
Celebrity	67,216	92,510	(27.34%)
Sentra	66,789	62,274	7.25%

* – Includes imports
( ) – Negative value

US Passenger Car Market Shares 2nd Qtr '88

Manufacturer	Sales	% Total
General Motors	1,061,239	36.94%
Ford	629,373	21.91%
Chrysler	324,600	11.30%
Honda/Acura	192,940	6.72%
Toyota	171,061	5.95%
Nissan	128,610	4.48%
Hyundai	77,467	2.70%
Mazda	65,331	2.27%
VW	48,816	1.70%
Subaru	39,236	1.37%
Total	2,872,825	

(Continued)

Passenger Car Market Share By Geographic Base

Second Quarter 1988

Manufacturers	Total Sales	Total Market Share
American	1,850,372	64.41%
Japanese	530,029	18.45%
European	133,844	4.66%
Transplants (VW, Honda, NUMMI, Nissan, Mazda/Ford)	225,539	7.85%
Other Imports (Excel, Festiva, Fox, LeMans, Precis)	132,978	4.63%
Total	**2,872,825**	**100.00%**

SECOND QUARTER DOMESTIC LIGHT TRUCK PRODUCTION

COMPANY	FULL-SIZE TRUCKS	COMPACT TRUCKS	FULL-SIZE VANS	COMPACT VANS	FULL-SIZE SPORTS UTILITY	COMPACT SPORTS UTILITY	TOTAL 1988	TOTAL 1987
FORD	178,600	95,885	63,419	50,102	16,031	30,328	434,365	401,457
CHEVROLET	133,941	75,132	43,951	43,707	38,103*	47,146	381,980	325,460
GMC	45,251	17,017	16,396	10,923	12,205	12,372	114,164	197,168
CHRYSLER	23,091	28,900	25,727	128,422	6238	—	212,378	197,168
JEEP	—	11,804	—	—	4325	65,167	81,296	62,381
NISSAN	—	20,631	—	—	—	—	20,631	21,887

*Includes Suburban and P-model

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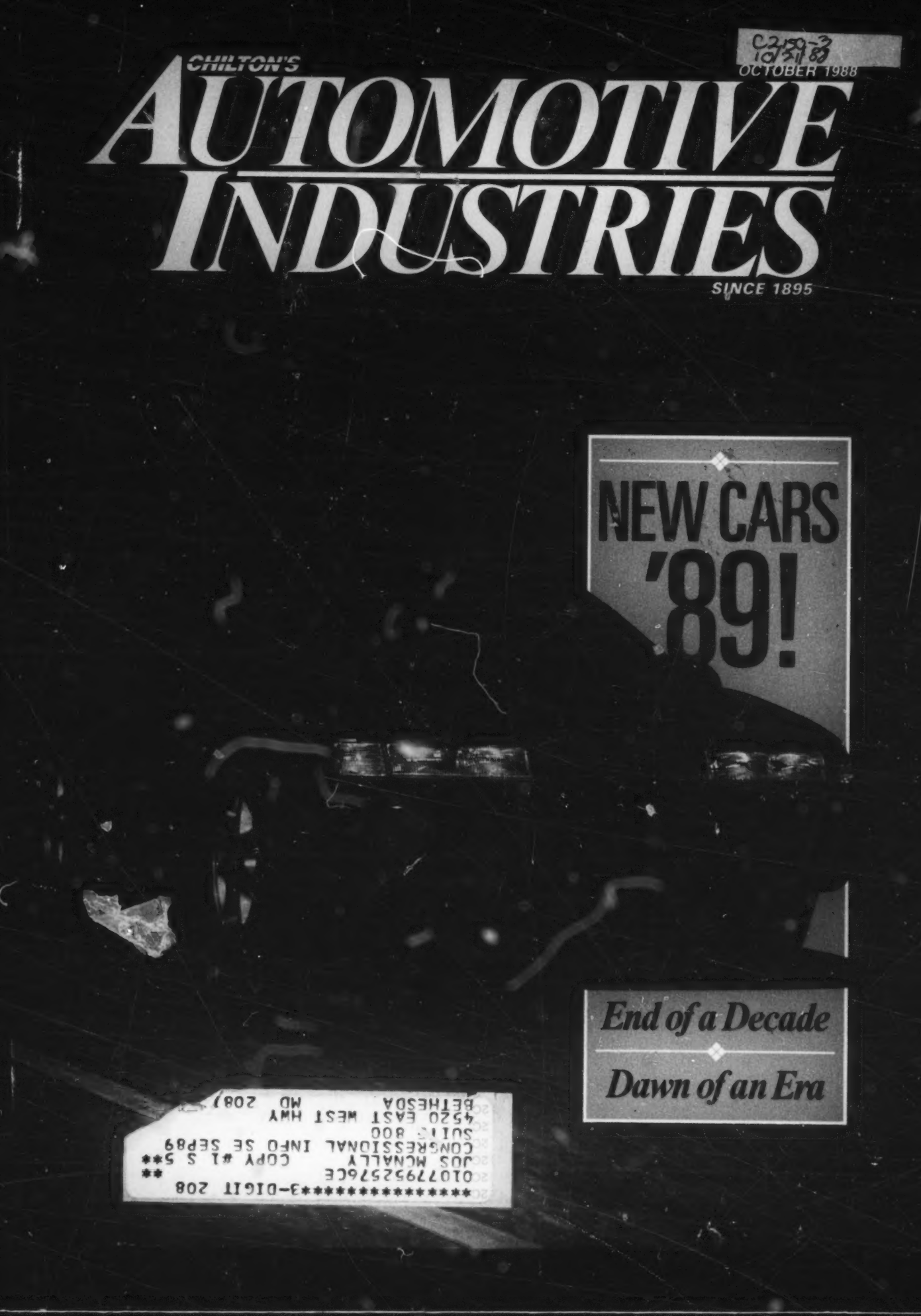

NEW CARS '89!

End of a Decade

Dawn of an Era

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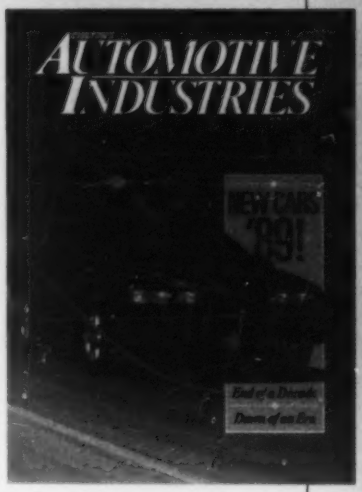

Ford's all-new Cougar and T-bird, along with Chevy's King Kong ZR-1 Corvette and the SHO Taurus, lead a performance resurgence from Detroit this season. Our coverage of the best of the '89s begins on page 40. Photography: Jay Asquini

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RVX SURVEY RESULTS

"Damn the torpedoes, full steam ahead!"

By John McElroy

If *AI* readers had anything to say about the feasibility and desirability of a Robotic Vehicle Expressway (RVX), the US would be building one today. Based on the results of the survey that ran in our August issue, *AI* readers demonstrate overwhelming support for the RVX concept. And though the survey response rate was small (161 respondents), we believe it reflects the sentiments of most people in the auto industry.

More than 96% of the respondents believe that the RVX concept is technically feasible, but perhaps more importantly, 75% of the respondents feel that it is a desirable project to pursue. Interestingly, 42% of the respondents believe the first 300-mile RVX segment could be in operation within 10 years, while fewer than 7% felt it would take more than 25 years. And 67% said it would have a positive impact on the auto industry.

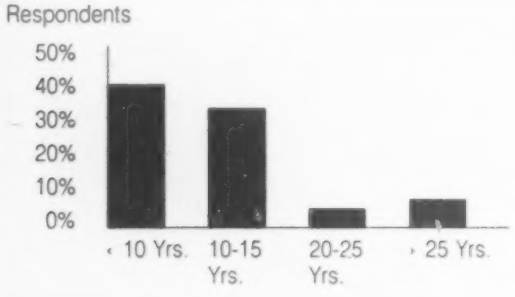
In these days of anti-tax-hike sentiments, it was encouraging to see that 63% of the respondents believe that the American public would support funding for RVX research.

When given the opportunity to choose how to distribute $10 billion in R&D for space programs, RVX or the national aerospace plane, *AI* readers give space programs a slight advantage. But when given the choice of how they would fund land-based personal transportation options, they chose RVX over efforts to reduce urban congestion, to install an American autobahn, or to develop an intelligent vehicle/roadway system. And 42% would support a funding level that would give the US a leadership position with RVX.

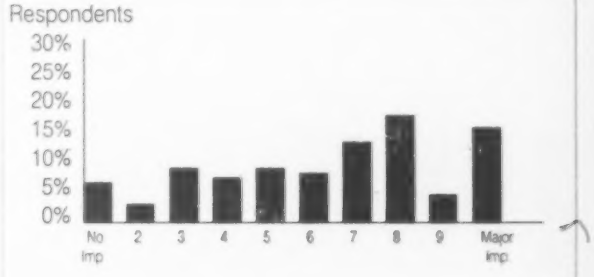
Though you might expect people in the US auto industry to reflect protectionist sentiments, 63% of the respondents would allow foreign companies to participate in an RVX program. "How would you keep them out?" asks one reader.

Importantly, over 48% of the respondents are degreed professionals, which indicates they have a good grasp of the technical hurdles that would have to be overcome. And one-third of the respondents are 40 to 50 years old, which reflects a mature and experienced age bracket.

When do you think the first 300-mile RVX segment could begin operation?



On a scale of 1 to 10, what impact will the RVX have on the US auto industry in the next 25 years?



Given $10 billion to spend on the following programs, what percentage would you distribute to each program?

Program	% of $10 Billion ‹ 20	20-40	40-60	60-80	› 80
Space	14.9%	34.7%	33.5%	11.8%	4.9%
RVX	19.8%	42.8%	30.4%	3.7%	1.8%
Aerospace Plate	41.6%	39.7%	9.9%	1.2%	0.6%

How would you personally distribute funding among the personal transportation options proposed in the RVX article?

Program	% of Funding ‹ 20	20-40	40-60	60-80	› 80
RVX	19.2%	32.2%	26.7%	10.5%	1.8%
Congestion reduction	34.1%	34.1%	17.3%	3.1%	1.2%
Intelligent vehicle/rdwy	34.1%	34.7%	13.6%	1.2%	---
US Autobahn	42.2%	11.1%	13.0%	2.4%	3.1%

RVX SURVEY RESULTS

1. **Do you believe the RVX is technically feasible?**
   96.2% Yes **3.7%** No
2. **Assuming the RVX is feasible, how desirable an addition is the RVX to the US transportation network?** (Check one box on the scale of 1 to 10 below)

1				5					10
5.6%	**7.4%**	**3.1%**	**1.8%**	**6.2%**	**5.6%**	**8.0%**	**21%**	**9.3%**	**31.6%**
NOT NEEDED									HIGHLY DESIRABLE

3. **When do you think the first 300 mile RVX segment could begin operation?**
   42.2% ‹ 10 years **4.9%** 20-25 years
   34.7% 10-15 years **6.8%** › 25 years
   9.9% 15-20 years
4. **What impact will RVX have on the US auto industry in the next 25 years?** (Check one box on the scale of 1 to 10 below)

1				5					10
5.6%	**3.1%**	**9.9%**	**6.8%**	**8.0%**	**7.4%**	**15%**	**18.6%**	**4.9%**	**21.1%**
NO IMPACT									MAJOR IMPACT

5. **Do you feel that the American public would support funding of RVX R&D?**
   63.3% Yes **36.7%** No
6. **Given $10 billion to spend on the following R&D programs, what % would you distribute to each program below?**

	Percentage				
	‹ 20	20-40	40-60	60-80	› 80
Space	**14.9%**	**34.7%**	**33.5%**	**11.8%**	**4.9%**
RVX	**19.8%**	**42.8%**	**30.4%**	**3.7%**	**1.8%**
Aerospace plane	**41.6%**	**39.7%**	**9.9%**	**1.2%**	**0.6%**

7. **How would you personally distribute funding among the personal transportation options proposed in the RVX article?**

	Percentage				
	‹ 20	20-40	40-60	60-80	› 80
RVX	**19.2%**	**32.2%**	**26.7%**	**10.5%**	**1.8%**
Urban congestion reduction	**34.1%**	**34.1%**	**17.3%**	**3.1%**	**1.2%**
Intelligent vehicle/roadway systems	**34.1%**	**34.7%**	**13.6%**	**1.2%**	---
U.S. Autobahn	**42.2%**	**11.1%**	**13.0%**	**2.4%**	**3.1%**

8. **What spending level would you select for RVX R&D for the next five years?** (NOTE: A one-year gas tax increase is presumed to fund five years of R&D)
   11.8% Zero **42.8%** Leadership (2.0 cent)
   11.1% Minimum start (0.5 cent) **13.6%** National priority (› 2.0 cent)
   21.1% Keep up (1.0 cent)
9. **If the US moves forward with an RVX program, should it permit foreign companies to participate?**
   63.3% Yes **31.6%** No
10. **What is your current position in the Automotive Industry?**
    .6% Production worker **27.3%** Middle management
    1.8% Office worker **6.8%** Executive
    47.8% Degreed professional **4.3%** Corporate Officer
    11.8% Other (specify) _____
11. **What is your age?**
    18.0% Less than 30 years old **14.9%** 50 to 60 years old
    26.7% 30 to 40 years old **9.3%** More than 60 years old
    31.6% 40 to 50 years old